APPLICATION DATA SHEET

This EMX2 Series starter and its accompanying CT's have been selected according to the Application Data detailed below. The starter must be operated with the CTs supplied. If applying the starter in an alternate application, or outside the maximum starter ratings listed, consult your local representative.

EMX2 STARTER APPLICATION RATINGS	
Model :	_____
Serial Number :	_____
CT Ratio :	_____ / 5
Connection Format	☐ 3 Wire ☐ 6 Wire
	☐ Bypassed
Maximum Starter FLC :	_____ Amps
Maximum Start Current :	_____ X FLC
Maximum Start Duration :	_____Secs
Maximum Starts/Hr :	_____ No
Maximum Amb Temp :	_____ ^{o}C

APPLICATION DATA	
Application Ref :	_____
	_____
Motor Data :	
Full Load Current	_____ Amps
kW	_____ kW
Driven Load Data :	
Machine Type	_____

This starter has been factory set as detailed below. Settings should be verified/modified at commissioning by following the **Initial Set Up** section of the Users manual. Commissioning settings and subsequent ammendmends should also be recorded in the spaces provided.

Function	Unit	Factory Setting	Installed Setting	Ammended	Ammended	Ammended
DATE		/ / CHKD	/ /	/ /	/ /	/ /
PRIMARY MOTOR SETTINGS						
1. Motor Full Load Current	Amps	☐				
2. Current Limit	% FLC	☐				
3. Initial Start Current	% FLC	☐				
4. Start Ramp Time	Secs	☐				
5. Soft Stop Ramp Time	Secs	☐				
6. Motor Start Time Constant	Secs	☐				
7. Phase Imbalance Protection		☐				
8. Undercurrent Protection	% FLC	☐				
9. Electronic Shearpin Protection	% FLC	☐				
10. -		☐				
COMMON PARAMETER SETTINGS						
11. Phase Sequence Protection		☐				
12. LCD Display Mode		☐				
13. CT Primary Ratio ------/5	Amps	☐				
14. - *factory setting do not adjust*						
15. - *factory setting do not adjust*						
16. - *factory setting do not adjust*						
17. - *factory setting do not adjust*						
18. - *factory setting do not adjust*						
19. - *factory setting do not adjust*						
20. Software Version						
SECONDARY MOTOR SETTINGS						
21. Motor Full Load Current	Amps	☐				
22. Current Limit	% FLC	☐				
23. Initial Start Current	% FLC	☐				
24. Start Ramp Time	Secs	☐				
25. Soft Stop Ramp Time	Secs	☐				
26. Motor Start Time Constant	Secs	☐				
27. Phase Imbalance Protection		☐				
28. Undercurrent Protection	% FLC	☐				
29. Electronic Shearpin Protection	% FLC	☐				
COMMON PARAMETER SETTINGS						
30. Restart Delay	Secs	☐				
32. Phase Imbalance Delay	Secs	☐				

GETTING STARTED

The chart below shows the major activities necessary to install and commission the EMX2 Series starter. It is recommended that all users refer to at least the sections listed, before commencing work. First time users of soft start technology, or the EMX2 are strongly encouraged to read this Users Manual completely prior to installation or commissioning.

PHYSICALLY INSTALL THE STARTER

refer sections :

5. Physical Specification

⇩

CONNECT DESIRED POWER CIRCUIT

refer sections :

6. Electrical Connection (Power Circuits)

⇩

CONNECT DESIRED CONTROL CIRCUIT

refer sections :

7. Electrical Connection (Control Circuits)

⇩

COMMISSION STARTER

refer sections :

8. Commissioning Procedure
9. EMX2 Programming Procedure
10. Trouble Shooting

SECTION 1 CAUTION STATEMENTS
Details possible causes of equipment damage

SECTION 2 GENERAL DESCRIPTION
Overview of EMX2 Series

SECTION 3 EMX2 FEATURE DESCRIPTIONS
- Start Modes
  - Uni-Start Constant Current
  - Uni-Start Current Ramp
- Uni-Stop Soft Stop
- Prestart Protection
- Run-Time Protection
  - Programmable Motor Thermal Model
  - Phase Imbalance Protection
  - Undercurrent Protection
  - Phase Sequence Protection
  - Thermistor Protection
  - Electronic Shearpin Protection
  - Restart Delay
  - Phase Imbalance Delay
  - Starter Overtemperature
- Run-Time Trip Warnings
- Digital Display
- Auto-configuration

SECTION 4 ELECTRICAL SPECIFICATION
- EMX2 Connection Detail
- General Specification
- Current Ratings

SECTION 5 PHYSICAL SPECIFICATION
- Dimensions / Weights
- Bus Bar
  - Configurations
  - Adjustment
- Mounting Precautions
- Enclosure Ventilation
- Mounting In Non-ventilated Enclosures
- Component Identification
  - Front Panel Display
  - Control Terminations

SECTION 6 ELECTRICAL CONNECTION (POWER CIRCUIT)

- EMX2 Current Transformer Installation & Connection
- Motor Connection
  3 Wire Motor Connection
  Wire Motor Connection
- Line Contactors
- Semiconductor Fuses
- Bridging Contactors
- Power Factor Correction
- Dual Speed Motors

SECTION 7 ELECTRICAL CONNECTION (CONTROL CIRCUIT)

- EMX2 Electronics & Fan Control Supply
- Control Inputs
  - Start
  - Stop
  - Reset
  - FLC Select
  - Emergency Stop
- Control Outputs
  - Main Contactor
  - Start/Run
  - Run
  - Trip
- Analogue Outputs
  - Motor Current
  - Motor Temperature
- Typical Installation Formats

SECTION 8 COMMISSIONING PROCEDURE

- Pre-commisssioning Checks
- Commissioning Procedure
- Post-commissioning Procedure

SECTION 9 EMX2 PROGRAMMING PROCEDURE

- Overview Of EMX2 Function Set
- Programming Procedure
  - Read Parameters
  - Program Parameters
- Function Adjustment Chart

SECTION 10 TROUBLE SHOOTING GUIDE

Step by Step guide

SECTION 1 CAUTION STATEMENTS

Overview : This section highlights potential causes of equipment damage

Content :

Caution List 1-1

CAUTION

This caution symbol is used throughout the EMX2 Manual to draw special attention to activities which may result in equipment damage. A summary of these cautions is listed below.

Such Caution Statements cannot cover every potential cause of equipment damage but can highlight common causes of damage. It is therefore the installers responsibility to adhere to all instructions in this manual, to follow good electrical practice and to seek advice before operating this equipment in a manner other than as detailed in this manual.

- Ensure that the EMX2 is completely isolated from the power supply before attempting any work on the unit.
- Entry of metal swarf into the cabinet can cause equipment failure.
- Do not apply voltage to the EMX2 control input terminals. These are active 12/24VDC inputs and must be controlled with potential free circuits.
- Do not connect Power Factor Correction capacitors to the output of the EMX2. If static power factor correction is employed, it must be connected to the supply side of the EMX2.
- Before installing the EMX2 without a line contactor ensure such connection meets local regulations and by-laws.
- If installing the EMX2 within a non-ventilated enclosure a by-pass contactor must be utilised to prevent excessive heat build-up.
- If installing a by-pass contactor ensure phase connections are correctly made
  ie L1-T1, L2-T2,L3-T3, or
  L1-L4, L2-L5, L3-L6, or
  1-2, 3-4, 5-6
- EMX2 protection features will be invalidated if :
  - the EMX2 CTs are installed inside by-pass and/or 6 wire circuits.
  - the EMX2 is programmed with an incorrect CT Primary Current (Function 13)
  - the EMX2 CTs do not have 5A secondaries
  - the CTs do not measure separate phases
- Removing control voltage from the EMX2 resets the thermal model.

The examples and diagrams in this manual are included solely for illustrative purposes. Users are cautioned that the information contained in this manual is subject to change at any time and without prior notice.

In no event will responsibility or liability be accepted for direct or indirect or consequential damages resulting from the use or application of this equipment.

SECTION 2 GENERAL DESCRIPTION

Overview : This section provides overview of EMX2 Series

Content :
General Description 2-1

General Description

The EMX2 Series is a microcontroller based soft starter incorporating the latest technologies and has been designed to provide a complete range of the most advanced soft start and motor protection features.

This Users Manual covers EMX2 models EMX2-0222 thru EMX2-1393.

In operation the EMX2 provides :

- improved soft start of motor and load
- reduced starting current
- improved soft stop of motor and load
- programmable motor thermal modelling
- phase sequence protection
- phase loss protection
- undercurrent protection
- electronic shear pin protection
- motor thermistor protection
- performance feedback

In addition, installation, commissioning and maintenance is made easy by the EMX2's many other sophisticated functions which enhance performance and reliability and make the equipment suitable for optimising practically all motor starting applications.

- automatic motor connection analysis and configuration
- automatic phase sequence analysis and configuration
- automatic supply voltage analysis and configuration
- automatic frequency analysis and configuration
- Uni-Start soft start
- current limiting
- full voltage starting
- run output
- trip output (Changeover)
- line contactor control
- by-pass contactor control
- motor run current display
- motor temperature display
- three wire or six wire operation
- Uni-Stop soft stop
- simple, accurate and repeatable programming procedures
- diagnostic fault display

SECTION 3 EMX2 FEATURE DESCRIPTIONS

Overview : This section describes the purpose and operation of each feature of the EMX2 Series Starters. [For Commissioning & Programming procedures refer sections 8 & 9]

Content :

Start Modes
- Uni-Start Constant Current 3-1
- Uni-Start Current Ramp 3-2

Uni-Stop Soft Stop 3-3
Prestart Protection 3-4
Run-Time Protection 3-5
- Programmable Motor Thermal Model 3-6
- Phase Imbalance Protection 3-8
- Undercurrent Protection 3-9
- Phase Sequence Protection 3-9
- Thermistor Protection 3-9
- Electronic Shearpin Protection 3-10
- Restart Delay 3-10
- Phase Imbalance Delay 3-10
- Starter Overtemperature 3-10

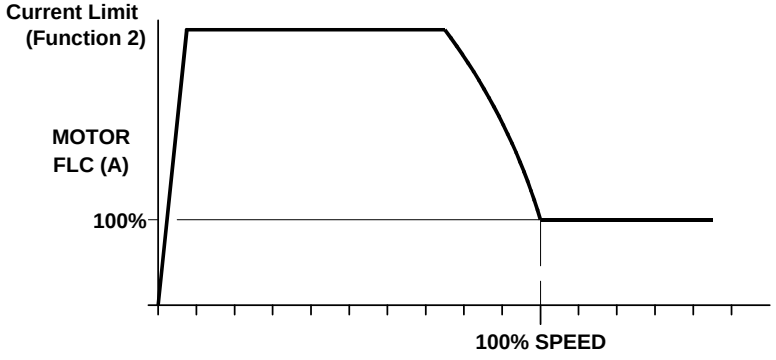
Run-Time Trip Warnings 3-11
Digital Display 3-11
Auto-configuration 3-12

Uni-Start Constant Current Soft Start

Uni-Start Constant Current soft start quickly ramps motor starting current to the user programmed Current Limit (Function 2). Voltage is then dynamically controlled to accurately maintain the programmed start current. Motor starting current remains at the programmed set point until full speed is approached and the current falls to run current levels.

A key feature of the EMX2 is the inclusion of Uni-Start technology. Uni-Start is an advanced method of control which dynamically adjusts starter output to match the motor characteristics as they change during starting and stopping. Uni-Start Control is operative in all EMX2 start and stop modes.

This feature eliminates the motor instability sometimes experienced with ordinary soft start systems. Uni-Start Constant Current provides particular advantage in pumping applications where both starting and stopping times can be adjust to minimise fluid hammer without the need for dedicated 'pump start' units.



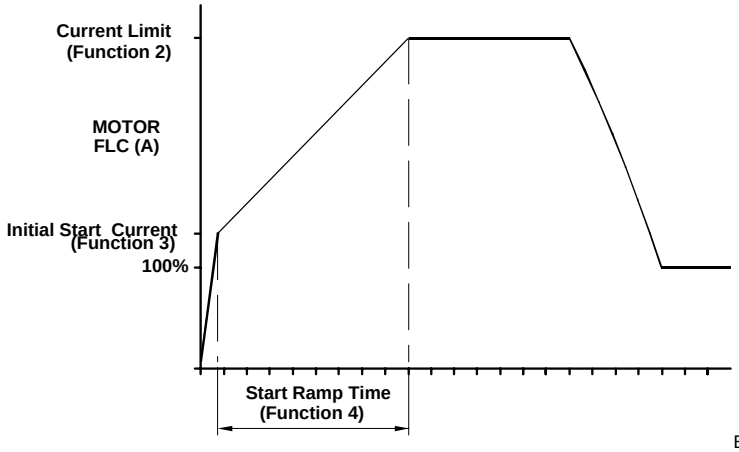
The required setting for the **Current Limit** function is installation dependant and should be programmed such that

a. at a minimum the motor is supplied start current sufficient to enable it to produce adequate torque to easily start the connected load.
b. desired starting performance is obtained.
c. EMX2 ratings are not exceeded, refer to the Application Data Sheet on the first page of this Users Manual.

FUNCTION 2	CURRENT LIMIT
Description	Sets the start current as a percentage of motor nameplate FLC, as set in Function 1 (Motor FLC). Start Current = Motor FLC (Function 1) X Current Limit (Function 2)
Display Units	% FLC (eg. 350%)
Limits/Range	Minimum : 100% Maximum : 550 %
Factory Setting	Refer Application Data sheet on page 1 of this manual

Uni-Start Current Ramp Soft Start

Uni-Start Current Ramp start mode modifies the Constant Current start mode by allowing the user to program both an Initial Start Current (Function 3) and a Start Ramp Time (Function 4), as well as the Current Limit (Function 2).



CURRENT RAMP should be considered in preference to CONSTANT CURRENT start mode in applications where :

a. required start torque can vary from start to start. ie conveyors : loaded, unloaded.
b. starting time of easily broken away loads needs to be lengthened. ie pumps
c. supply capacity is limited. ie generator sets.

The Current Limit (Function 2) should be set so that the motor can accelerate easily to full speed.

The Initial Start Current (Function 3) should be set such that the motor begins to rotate as soon as a start is called for. Setting the Initial Start Current equal to the Current Limit (Function 2) defeats the Current Ramp Mode.

The Start Ramp Time (Function 4) should be set to optimise overall starting characteristics for the connected load. Setting the Start Ramp Time to 0 seconds defeats the Current Ramp Mode.

FUNCTION 3	INITIAL START CURRENT
Description	Sets the initial start current as a percentage of motor nameplate FLC, as set in Function 1 (Motor FLC).
Display Units	% FLC (eg 230%)
Limits/Range	Minimum : 100% Maximum : 550 %
Factory Setting	Refer Application Data sheet on page 1 of this manual

FUNCTION 4	START RAMP TIME
Description	Sets the rate at which current rises from the Initial Start Current (Function 3) to the Current Limit (Function 2).
Display Units	Seconds
Limits/Range	Minimum : 0 sec Maximum : 30 sec
Factory Setting	Refer Application Data sheet on page 1 of this manual

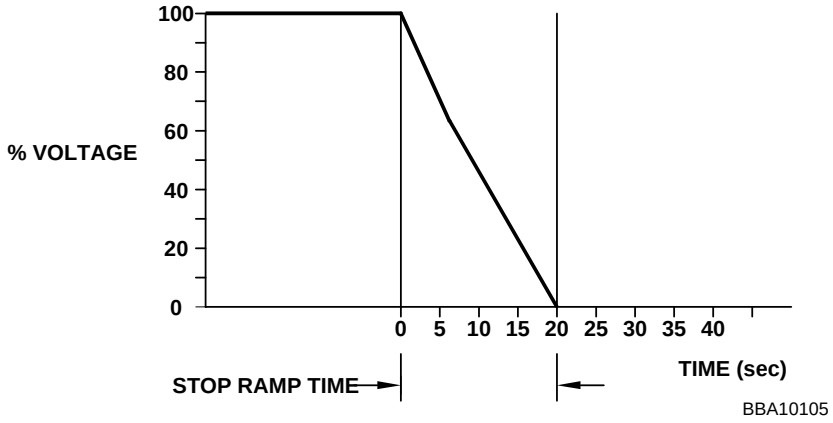
Uni-Stop Soft Stop

The EMX2 is equipped with a user selectable and adjustable Uni-Stop soft stop function (0s - 100s).

Uni-Stop Soft Stop, when enabled, reduces the voltage applied to the motor, causing the motor to stall and decelerate to zero speed. The effect of this is to add inertia to the load and thereby reduce the rate of deceleration.

Uni-Stop technology dynamically adjusts starter output to match the motor characteristics as they change during stopping.

Uni-Stop Soft Stop eliminates the motor instability sometimes experienced with ordinary soft stop systems. Uni-Stop provides particular advantage in pumping applications where both starting and stopping times can be adjusted to minimise fluid hammer without the need for dedicated 'pump soft start' units.



If utilising the Uni-Stop Soft Stop function and a line contactor, the contactor must not be opened until the end of the stop ramp time. The EMX2's Main Contactor Control relay can be used to provide appropriate contactor control.

The Soft Stop Ramp Time (Function 5) should be adjusted such that it provides optimum stopping performance for the application. Setting the Soft Stop Ramp Time to 0 seconds defeats the soft stop function.

FUNCTION 5	SOFT STOP RAMP TIME
Description	Sets the soft stop ramp time for soft stopping of the motor. Set the ramp time for 0 (zero) seconds for no soft stop.
Display Units	Seconds
Limits/Range	Minimum : 0 sec Maximum : 100 seconds
Factory Setting	Refer Application Data sheet on page 1 of this manual

Protection

The EMX2 provides an integrated protection package which operates on three levels to prevent damage and also to allow management of motor operation so as to avoid trip conditions.

- Prestart Circuit Analysis/Configuration
- Run-time Protection Systems
- Run-time Trip Warnings

Prestart Circuit Analysis & Configuration

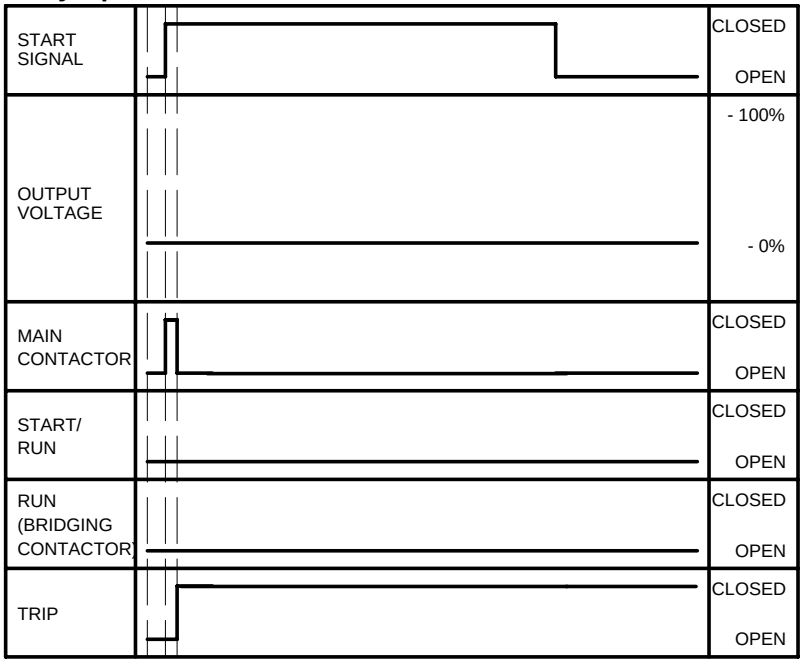
To prevent damage from incorrect installation or supply problems the EMX2 Series starters perform an automatic system analysis at the first start after each power up of the control voltage to the EMX2. Tests performed include :

- Motor circuit
- Motor connection configuration
- Frequency range
- Voltage range
- Supply circuit

Upon successful completion of the tests voltage is applied to the motor. Failure of any of these pre-start checks causes the EMX2 to :

- trip and illuminate the appropriate indication. (Refer to Trouble Shooting Section later in this manual)
- change the state of the trip relay contacts.

Relay Operation



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Run-time Protection

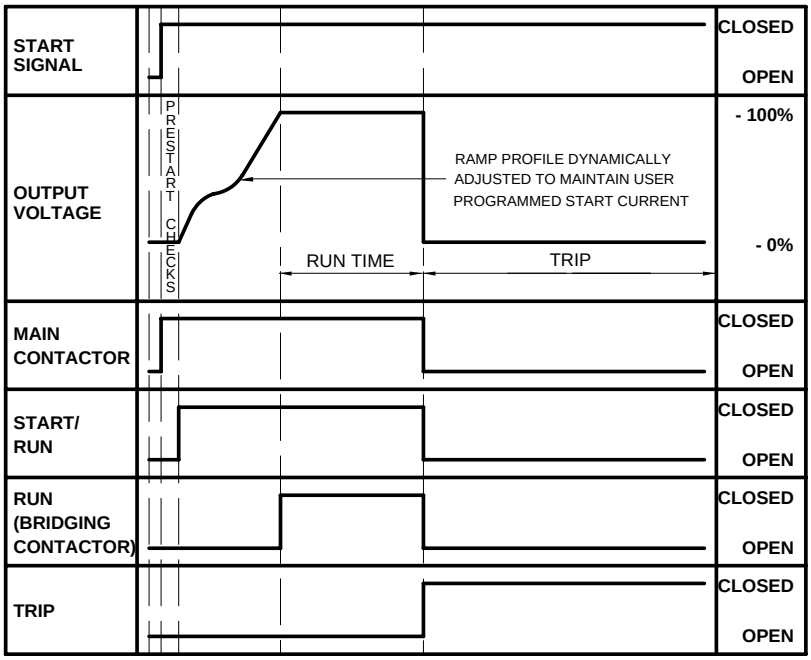
The EMX2 starters provide the following run-time protection systems.

- Programmable Motor Thermal Modelling
- Phase Imbalance Protection
- Thermistor Protection
- Undercurrent Protection
- Shearpin Protection
- Starter Overtemperature Protection
- Phase Sequence Protection

Operation of any of these protection features causes the EMX2 to :

- trip and illuminate the appropriate indication. (Refer to Trouble Shooting Section later in this manual)
- change the state of the trip relay contacts.

Relay Operation : Run-Time Trips



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Run-Time Protection in By-passed Starters

EMX2 run-time protection features remain operative even when the starter is by-passed with a bridging contactor provided the EMX2 CT's are not also by-passed. Refer to the Electrical Installation section later in this manual.

Resetting Run-Time Trips

Run time trips may be reset by operation of the EMX2's reset contact.

CAUTION

REMOVAL OF CONTROL VOLTAGE TO RESET TRIP CONDITIONS RESETS MOTOR THERMAL MODEL

Operational Overview (Protection Features)

1) OFF mode.	In the OFF mode, the starter microcomputer monitors the thermistor inputs and models motor temperature. a) If the thermistor input is connected to a circuit of resistance greater than 2kohm, the starter will enter the TRIP mode. b) If the thermal model exceeds 1.05, the starter will enter the TRIP mode.
2) PRESTART mode.	In the PRESTART mode, the main contactor relay output is closed, the starter microcomputer measures the supply frequency, motor connection ,phase sequence and the presence of all phases. Depending on the results of these measurements, either auto configures itself and enters the START mode, or trips on an installation or phase sequence fault.
3) START mode	In the START mode, the starter microcomputer monitors the thermistor inputs, the phase imbalance and models motor temperature. a) If the thermistor input is connected to a circuit of resistance greater than 2kohm, the starter will enter the TRIP mode. b) If the thermal model exceeds 1.05, the starter will enter the TRIP mode. c) If the Phase Imbalance protection operates, the starter will enter the TRIP mode. d) If the output voltage from the starter reaches full voltage, the starter will enter the RUN mode.
4) RUN mode	In the RUN mode, the starter microcomputer monitors the thermistor inputs, the phase imbalance,.motor run current and models motor temperture. a) If the thermistor input is connected to a circuit of resistance greater than 2kohm, the starter will enter the TRIP mode. b) If the thermal model exceeds 1.05, the starter will enter the TRIP mode. c) If the Phase Imbalance protection operates, the starter will enter the TRIP mode. c) If the undercurrent protection operates, the starter will enter the TRIP mode. d) If the shear pin protection operates, the starter will enter the TRIP mode.
5) SOFT STOP mode	a) If the stop time is zero, the starter immediately enters the OFF mode. b) If the thermistor input is connected to a circuit of resistance greater than 2kohm, the starter will enter the TRIP mode. c) If the thermal model exceeds 1.05, the starter will enter the TRIP mode. d) If the Phase Imbalance protection operates, the starter will enter the TRIP mode. e) As the output voltage approaches zero, the starter enters OFF mode.
6) TRIP mode	In TRIP mode, the main contactor, run and start/run contacts are open and the TRIP relay changes mode. SCR conduction is inhibited. a) If the RESET is closed, the starter enters the OFF mode.

Programmable Thermal Motor Modelling

Optimum motor overload protection is provided by the EMX2 through a user programmable thermal motor model.

Programmed with actual motor thermal characteristics from the motor's data sheet, the EMX2 is able to thermally model motor temperature. This ensures accurate protection while still enabling the motor to work to its maximum capability during both start and overload conditions.

Determining The <u>Maximum</u> Motor Start Time Constant (MSTC)

The EMX2 thermal protection is adjusted by setting the Motor Start Time Constant (MSTC) (Function 6) according to the motor's thermal capacity.

A motor's thermal capacity can be expressed as the maximum time (seconds) a motor can maintain locked rotor current conditions, and is often referred to as :

Maximum Locked Rotor Time
or Maximum DOL Start Time

The motor's thermal capacity can also be expressed as the maximum load inertia at the motor shaft.

This information is available from motor data sheets, or direct from the motor supplier. From this information the maximum Motor Start Time Constant (MSTC) figure may be determined as follows :

1. MSTC = Motor Locked Rotor Time

The motors Maximum Locked Rotor Time, or Maximum DOL Start Time, expressed in seconds may be used directly as the maximum Motor Start Time Constant (MSTC) for programming into the EMX2.

Motor Start Time Constant = Maximum Locked Rotor Time

2. MSTC = Normalised Motor Locked Rotor Time

For greater accuracy, the motor's Maximum Locked Rotor Time and Locked Rotor Current figure can be used together to calculate a normalised maximum MSTC figure as shown below :

$$MSTC = \left(\frac{\%LRC}{600}\right)^2 \text{ X Motor Locked Rotor Time}$$

example : Motor Maximum Locked Rotor Time = 14 seconds
Motor Locked Rotor Current (%) = 650%

$$MSTC = \left(\frac{650\%}{600}\right)^2 \text{ X } 14 = 16\text{seconds}$$

Determining The Appropriate Motor Start Time Constant (MSTC) Setting

The MSTC figure, as calculated above, represents the motor's maximum thermal capacity, and when used to program the EMX2 will provide accurate motor protection while also allowing the motor to be operated to its maximum overload capability.

MSTC figures less than the maximum, as calculated above, may also be used when programming the EMX2 Thermal Model. Using conservative MSTC settings should be considered where maximum motor overload capacity is not necessary for normal motor/load operation. Such settings will trip the motor earlier, thereby avoiding any unnecessary motor heating.

If maximum motor thermal capacity is not required, a reduced setting may be established by observing the modelled motor temperature, as shown on the EMX2 LCD Display, and adjusting the MSTC parameter such that after a normal start which has been preceded by a period of running at maximum load, the calculated motor temperature is approaching 100%.

Operation

Motor temperature is continuously modelled by the EMX2, even when the motor is not running. Control voltage to the EMX2 must be maintained at all times to ensure

the accuracy of thermal calculations. Removing control voltage from the EMX2 resets the thermal model to zero.

When commissioning, or re-comissioning after removal of control voltage from the EMX2, verify that the motor is cold before starting the motor to ensure accurate thermal modelling.

Accuracy of the thermal model is compromised if the motor is operated outside its specification. ie ambient temperature is in excess of rated ambient, motor cooling fan is blocked or inoperative etc. Motor Thermistor protection should be used to detect such abnormal conditions.

FUNCTION 6	MOTOR START TIME CONSTANT (MSTC)
Description	Sets the motor thermal capacity used by the EMX2 thermal model.
Display Units	Seconds
Discrimination	1 second
Limits/Range	Minimum : 5 sec Maximum : 60 seconds
Factory Setting	Refer Application Data sheet on page 1 of this manual

Phase Imbalance Protection

Phase Imbalance Protection protects the motor against phase imbalance situations, either before or after the starter.

The EMX2 monitors the three phase currents and bases its calculations on the difference between the highest phase current and the lowest phase current. The readings are averaged before the calculation requiring that there is an imbalance in the average currents drawn.

The allowable phase imbalance is user adjustable. The parameter sets the trip level in approximately* ten percent increments, ie a setting of '2' will cause a trip if the high phase has an average current of 120% of the lowest phase. This is an imbalance of about 10% from the average current.
(* accuracy subject to tolerance in current monitoring circuit.)

The phase imbalance protection sensitivity is reduced during starting and stopping to accommodate the discontinuous waveform.

To ensure maximum motor protection, the Phase Imbalance Protection (Function 7) should be set to as high a sensitivity as possible without causing nuisance tripping.

FUNCTION 7	PHASE IMBALANCE PROTECTION
Description	Sets the percentage imbalance allowed between phases while the motor is operating.
Display Units	Sensitivity level (1,2,3 ,4,5,6,7,8,9,10) Settings . 1 minimum imbalance (highest sensitivity) : : 10 maximum imbalance (lowest sensitivity)
Factory Setting	Refer Application Data sheet on page 1 of this manual

Undercurrent Protection

The EMX2 provides an undercurrent trip which may be adjusted to trip the starter if the motor current falls below a pre-programmed minimum current level.

Undercurrent protection can be used to detect changes in motor loading which may indicate system malfunction. For instance in pumping applications a low motor current may indicate a pump is running 'dry' and thus in danager of suffering damage This feature will also detect an open circuit on the output of the starter.

If required, Undercurrent Protection (Function 8) should be set below the minimum running current of the machine but above the magnetising current of the motor. Settings lower than the motor's magnetising current (typically 25% to 35%) limit the protection to detection of open circuit protection only. The practical lower limit is 5%.

The Undercurrent Protection is enabled once the motor has reached full speed.

FUNCTION 8	UNDERCURRENT PROTECTION
Description	Sets the lower limit (trip point) for motor load as a percentage of motor nameplate FLC as programmed in Function 1 (Motor Full Load Current)
Display Units	% (percentage)
Limits/Range	Minimum : 0 % Maximum : 100 %
Factory Setting	Refer Application Data sheet on page 1 of this manual

Phase Sequence Protection

The EMX2 provides a user programmable phase sequence protection which, if enabled, inhibits motor operation if a prohibited phase sequence is detected.

The Phase Sequence Protection (Function 11) must be disabled (Set to zero) if the EMX2 is used with reversing contactors on the input.

FUNCTION 11	PHASE SEQUENCE PROTECTION
Description	Sets valid phase sequences for phase sequence protection. Invalid phase sequences prevent operation.
Display Units	Valid Phase Sequences Valid Phase Sequences . 0 forward and reverse (no protection) 1 forward (positive) only (EMX2 trips on reverse phase sequence) 2 reverse (negative) only(EMX2 trips on forward phase sequence)
Factory Setting	Refer Application Data sheet on page 1 of this manual

Thermistor Protection

PTC Motor thermistors, if fitted in the motor, may be directly connected to EMX2.

If motor thermistors are not connected, the thermistor inputs terminals (28 & 29) must be linked. The thermistor circuit should be run in screened cable and must be electrically isolated from earth and all other power and control circuits.

Threshold resistance - 1800 ohms
Thermistor Current - less than 1.5mA

Electronic Shearpin

The EMX2 provides an Electronic Shearpin protection function which can be adjusted to trip the starter if motor current exceeds a pre-programmed maximum current.

Electronic Shearpin protection can be used to detect changes in motor loading which may indicate the motor is about to jam, thereby allowing the starter to trip and prevent mechanical damage to the motor, drive chain and/or machine.

The Electronic Shearpin Protection (Function 9) should generally be set equal to Current Limit (Function 2), but may be altered to a lower setting if required.

The Electronic Shearpin Protection is enabled once the motor has reached full speed.

FUNCTION 9	ELECTRONIC SHEARPIN PROTECTION
Description	Sets the upper limit (trip point) for motor current as a percentage of motor nameplate FLC as programmed in Function 1 (Motor Full Load Current)
Display Units	% FLC
Limits/Range	Minimum : 1% Maximum : 900%
Factory Setting	Refer Application Data sheet on page 1 of this manual

Restart Delay

The Restart Delay allows the user to program a delay period between the end of a stop and the beginning of the next start. This feature can be used to prevent inadvertent abuse of the starter and motor caused by high frequency cyclic start/stop commands.

FUNCTION 30	RESTART DELAY
Description	Sets the minimum time between the end of a stop and the beginning of the next start.
Display Units	Seconds (approximate)
Limits/Range	Minimum : 1 second Maximum : 255 seconds
Factory Setting	Refer Application Data sheet on page 1 of this manual

Phase Imbalance Delay

The Phase Imbalance Delay allows the user to program the minimum time a phase imbalance must be present before the EMX2 will trip the motor.

FUNCTION 32	PHASE IMBALANCE DELAY
Description	Sets the minimum time a phase imbalance must be present before the EMX2 Phase Imbalance protection trips.
Display Units	Seconds (approximate)
Limits/Range	Minimum : 1 second Maximum : 254 seconds

Starter Overtemperature

The EMX2 is protected from overtemperature operation by sensors on each of the three power modules.

Overtemperature situations cause the EMX2 to trip, and it may not be re-started until the temperature of the power module heatsink assemblies has dropped.

Run-time Trip Warnings

The EMX2 units provides indication and interface of the following three functions which can provide feedback on approaching trip conditions.

- Overload Operation
- Motor Current (% FLC)
- Thermally Modelled Motor Temperature (%)

FUNCTION	DISPLAY TYPE		
	LED	LCD	4-20mA
Overload Operation	YES	NO	NO
Motor Current	NO	YES	YES
Motor Temperature (Thermal Model)	NO	YES	YES

Overload Operation

The Overload LED on the Front Panel Display illuminates when motor current exceeds the motor Full Load Current (FLC) as set in Function 1.

Extended illumination of the Overload LED indicates that an overload trip is approaching should motor current remain high. Pulsing of the Overload LED indicates transient overloads are being experienced. Such momentary overloads may be part of normal operation for the connected load. Extended, severe and/or too frequent transient overloads may cause motor thermal trips.

Motor Current

Provided as both an LCD readout and 4-20mA signal

LCD : Refer to Digital Display description later in this section.

4-20mA : Refer to Analogue Outputs description in the Electrical Connection (Control Circuit) section of this manual.

Motor Temperature (Thermal Model)

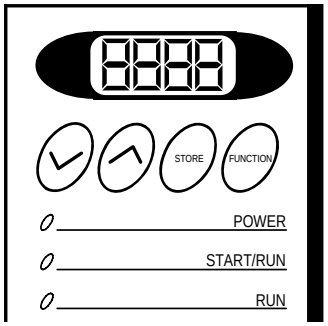
Provided as both an LCD readout and 4-20mA signal

LCD : Refer to Digital Display description later in this section.

4-20mA : Refer to Analogue Outputs description in the Electrical Connection (Control Circuit) section of this manual.

Digital Display

The Digital Display, located on the front face of the EMX2, is used for both starter programming and displaying run-time parameters.



Program Mode

Refer EMX2 Programming Procedure section later in this manual.

Display Mode

During run, the LCD display may be programmed to display motor current, motor temperature or alternate between the two.

Motor Current :

Display Units	Amps
Limits/Range	Minimum : 0 A Maximum : Dependant on CT's

Note that the integrity of the current display is subject to the EMX2 being correctly programmed with Primary Rating of the connected CTs. During commissioning of the EMX2 the LCD current display should not be relied upon until its operation has been verified by measuring motor current by an independent means.

Thermally Modelled Motor Temperature:

Display Units	% percentage
Limits/Range	Minimum: 0% Maximum : 105%

The motor temperature is displayed as a percentage of the maximum motor temperature as calculated by the Thermal Model. The motor temperature display is indicated by a leading decimal point. ie 90% reads as .90 and 100% as 1.00. The EMX2 will trip when the motor temperature reaches 1.05.

FUNCTION 12	LCD RUN TIME DISPLAY MODE
Description	Sets the parameter shown on LCD display during run
Display Units	Parameter Options (0,1,2) Parameter Options . 0 Motor Current (Amps) 1 Motor Temperature (Thermal Model)(%) 2 Current / Motor Temperature
Factory Setting	Refer Application Data Sheet On Page 1 Of This Manual

Auto-configuration

The EMX2 automatically determines the motor connection, supply frequency, supply voltage & phase sequence and configures the internal parameters for correct operation, or inhibits operation if a problem is detected.

At start, the EMX2 is able to determine and configure for 3 Wire or 6 Wire operation.

The EMX2 will auto-select for 50Hz or 60Hz operation.

The EMX2 will operate for line input voltages as follows

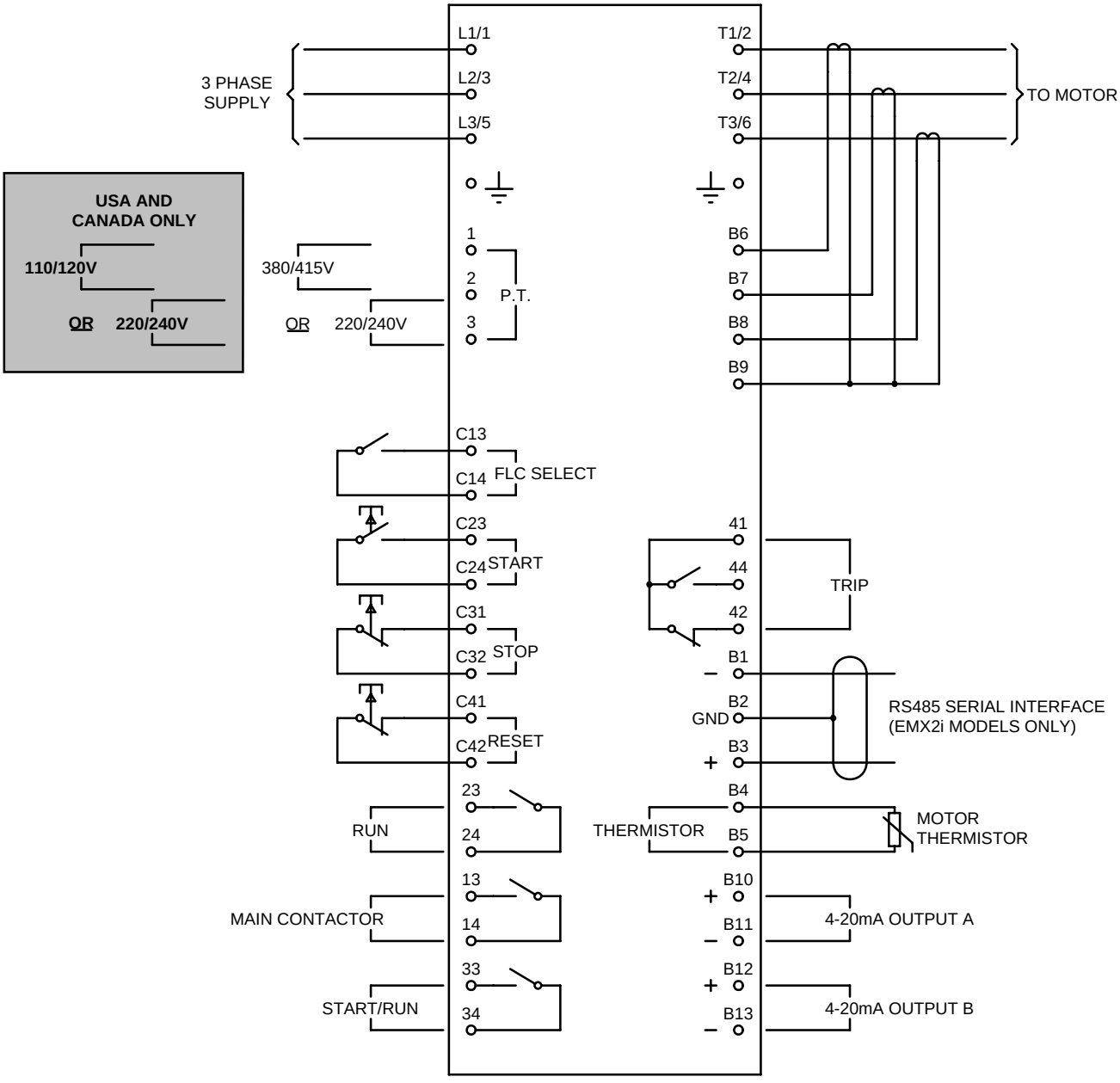
3 wire connection : 220 VAC to 600 VAC
6 wire connection : 220 VAC to 440 VAC

SECTION 4 ELECTRICAL SPECIFICATION

Overview : This section details the general electrical specification of the EMX2 Series Starters.

Content :
EMX2 Connection Detail 4-1
Specifications 4-2
Current Ratings 4-3

EMX2 CONNECTION DETAIL



SPECIFICATIONS The following specifications are common to all models:-

Power Circuit:	Reverse parallel connected thyristors (full wave control)
Supply Voltage:	220 VAC to 600 VAC (3 Wire) 220 VAC to 440 VAC (6 Wire) Consult local representative for other voltages
Supply Frequency:	48Hz to 52Hz, 58Hz to 62Hz
Control Voltage:	Refer Marking On Equipment
Fan Voltage:	Refer Marking On Equipment
Current Rating:	Refer to Table Of Ratings overleaf
Motor Connection:	3 Wire or 6 Wire
Control Inputs:	Active 24 VDC, 8mA approx (C13,C14) FLC Select (C23,C24) Start (C31,C32) Stop (C41,C42) Reset
Relay Outputs:	5A @ 250VAC/360VA, 5A @ 30VDC Resistive (23,24) Run (Bridging Contactor Control) (N.O.) (13,14) Main Contactor Control (N.O.) (33,34) Start/Run (N.O.) (41,42,44) Trip (C/O)
Indicators:	Power On, Start/Run, Run, Overload, Phase Sequence, Overcurrent, Undercurrent, Phase Loss, Thermistor, Shearpin, Installation Fault, Overtemperature Fault
Environmental:	Degree of Protection: IP00 Form Designation: Form 1 Rated Insulation Voltage: 2 kV Rated Impulse Voltage: 2 kV Pollution Degree: 3 Rated Short-circuit Current: 50 kA Equipment Class (EMC): Class A. This product has been designed for Class A equipment. Use of the product in domestic environments may cause radio interference, in which case the user may be required to employ additional mitigation methods.
Ambient Temperature:	0^{o}C to 45^{o}C (Operating) -5^{o}C to 65^{o}C (Storage)
Approved To:	UL508 CSA 22.2 No 14. C✓ (CISPR-11) CE (IEC947-4-2)

Continuous Ratings

	100% DUTY CYCLE (Off Time = 0 seconds)					
	Light Load 300% x FLC, 10 Sec 10 Starts/Hr, 45°C AC53a 3-10:100-10		Medium Load 350% x FLC, 15 Sec 10 Starts/Hr, 45°C AC53a 3.5-15:100-10		Heavy Load 450% x FLC, 30 Sec 10 Starts/Hr, 45°C AC53a 4.5-30:100-10	
	3 Wire	6 Wire	3 Wire	6 Wire	3 Wire	6 Wire
EMX2-0222	222A	333A	197A	296A	149A	224A
EMX2-0283	283A	425A	253A	379A	190A	285A
EMX2-0359	359A	538A	321A	481A	239A	359A
EMX2-0451	451A	676A	409A	613A	296A	444A
EMX2-0523	523A	784A	474A	711A	345A	518A
EMX2-0621	621A	932A	568A	851A	407A	610A
EMX2-0721	721A	1081A	663A	995A	473A	709A
EMX2-0842	842A	1263A	780A	1170A	544A	816A
EMX2-0892	892A	1338A	834A	1251A	579A	869A
EMX2-1192	1192A	1788A	1020A	1530A	745A	1117A
EMX2-1393	1393A	2089A	1295A	1942A	929A	1393A

Bypassed Ratings

	10 STARTS PER HOUR					
	Light Duty 300% x FLC, 10 Sec 10 starts/Hr, 45°C AC53b 3-10:350		Medium Duty 350% x FLC, 15 Sec 10 starts/Hr, 45°C AC53b 3-15:345		Heavy Duty 450% x FLC, 30 Sec 10 starts/Hr, 45°C AC53b 4.5-30:330	
	3 Wire	6 Wire	3 Wire	6 Wire	3 Wire	6 Wire
EMX2-0222	242A	364A	205A	308A	152A	228A
EMX2-0283	314A	471A	265A	397A	194A	292A
EMX2-0359	374A	562A	321A	481A	246A	369A
EMX2-0451	534A	802A	440A	659A	306A	460A
EMX2-0523	594A	891A	508A	763A	356A	535A
EMX2-0621	754A	1131A	616A	925A	422A	633A
EMX2-0721	893A	1339A	726A	1089A	493A	740A
EMX2-0842	1084A	1627A	868A	1302A	571A	856A
EMX2-0892	1176A	1764A	939A	1408A	611A	917A
EMX2-1192	1462A	2192A	1178A	1767A	790A	1185A
EMX2-1393	2053A	3079A	1665A	2496A	1122A	1682A

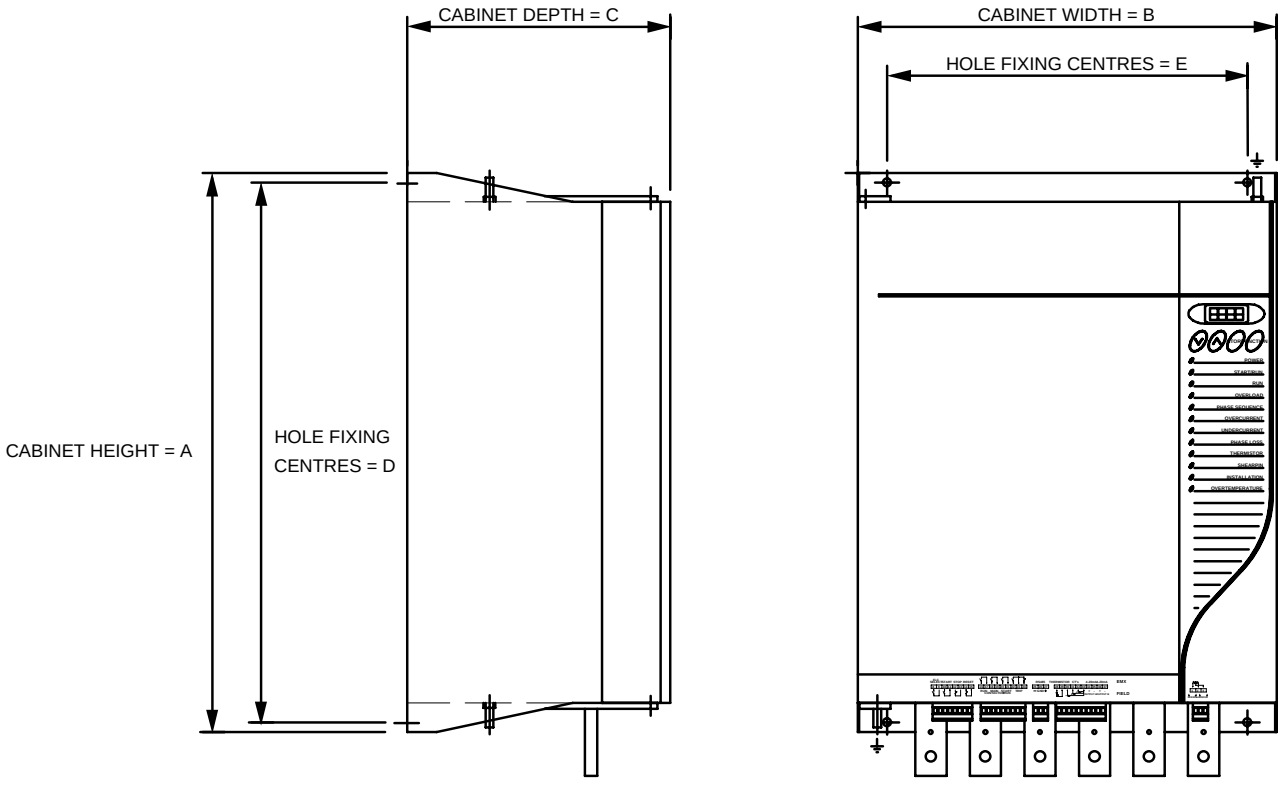
SECTION 5 PHYSICAL SPECIFICATION

Overview : This section details the mounting detail, bus bar configuration and ventilation options for the EMX2 Series Starters.

Content :

Dimensions / Weights 5-1
Bus Bars
- Configurations 5-2
- Adjustment 5-3
Mounting Precautions 5-3
Enclosure Ventilation 5-3
Mounting In Non-ventilated Enclosures 5-4
Component Identification
- Front Panel Display 5-4
- Control Terminations 5-4

Dimensions

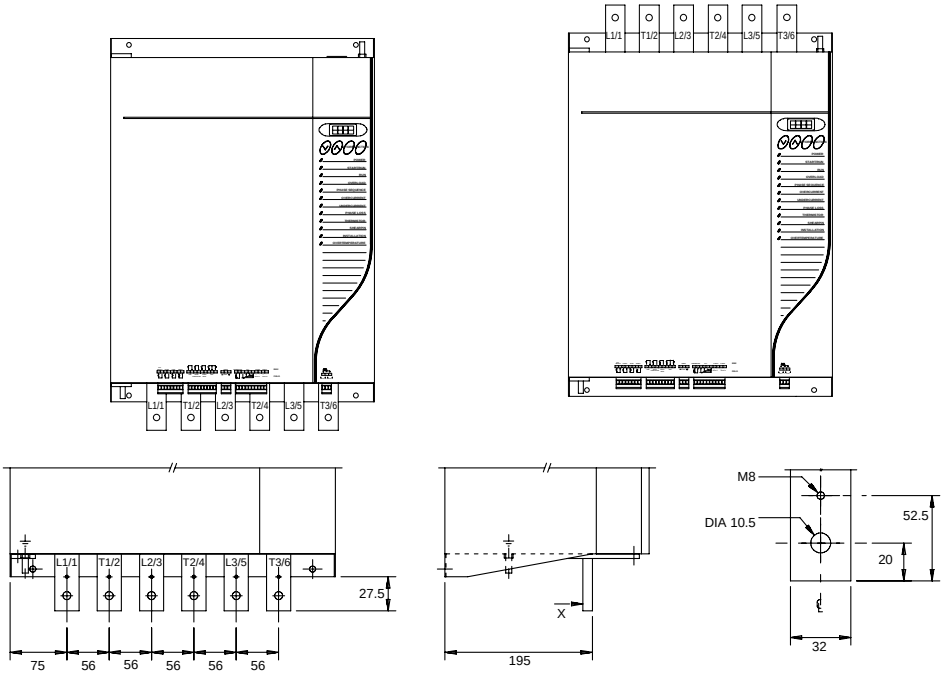


MODEL	A	B	C	D	E	WEIGHT
EMX2-0222, EMX2-0283	575	430	270	555	370	39KG
EMX2-0359, EMX2-0451						40KG
EMX2-0523, EMX2-0621						42KG
EMX2-0721, EMX2-0842						50KG
EMX2-0892						50KG
EMX2-1192, EMX2-1393	700	560	320	670	500	110KG

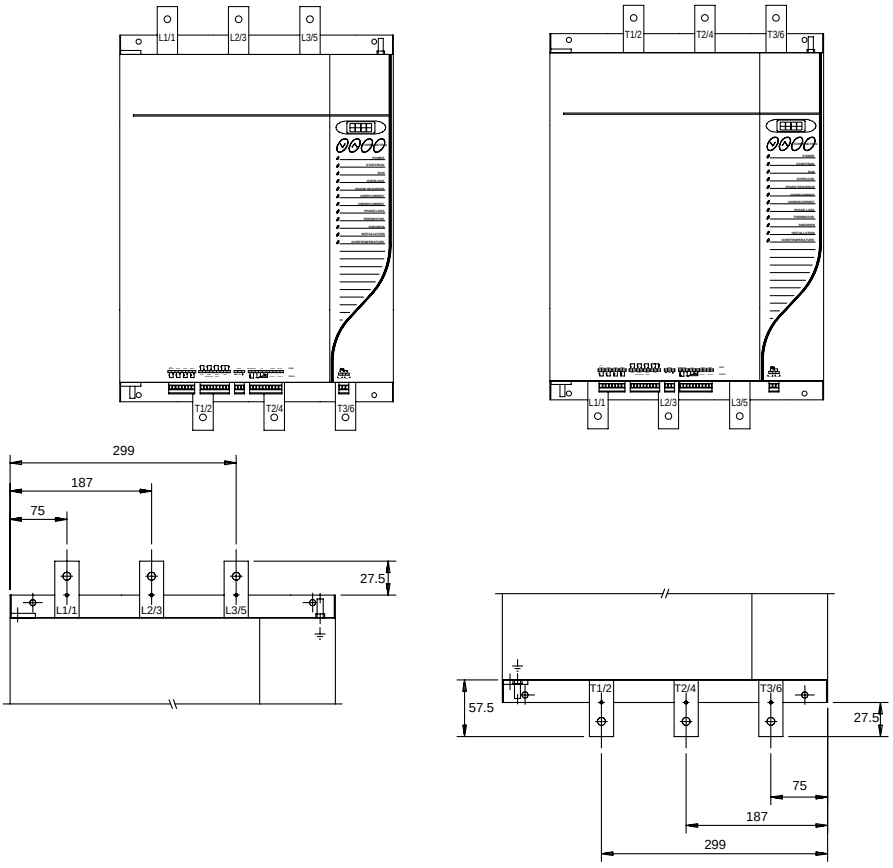
Input/Output Terminal Configuration

The EMX2 units offer four different input/output power terminal configurations. The Bus Bar configuration is user adjustable.

Same End Termination Detail



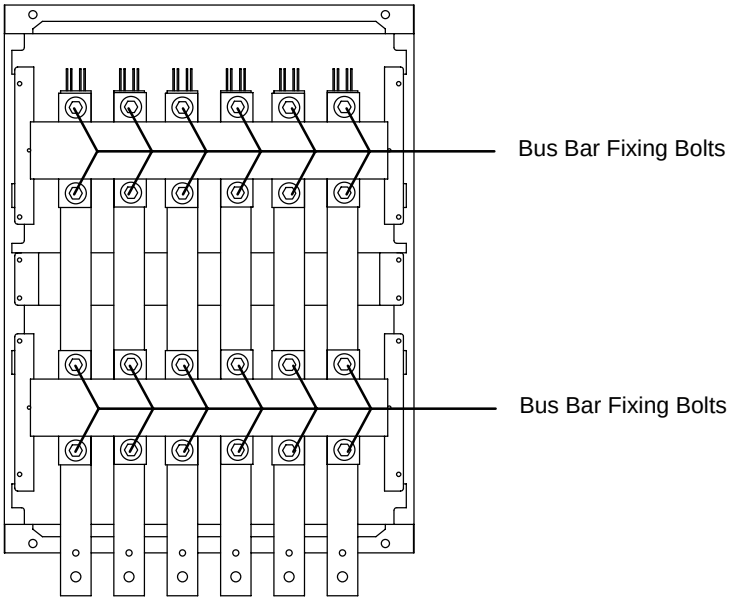
Split Termination Detail



Bus Bar Adjustment

To change the bus bar configeration open the EMX2 cover, loosen and remove the bus bar fixing bolts (refer diagram below) and slide the bus bar out of the EMX2. Then, having oriented the bus bars according to the desired configuration, slide them back into the starter. Fit the fixing bolts and re-tighten to a torque of 8.5 Nm..

Care must be taken to ensure that foreign matter does not contaminate the jointing compound and become trapped between the bus bar and its mounting plate.



Mounting Precautions

Do not mount in direct sunlight
Do not locate near heat radiating elements
Mount the EMX2 vertically
Do Not Obstruct air intakes / exhaust

Enclosure Ventilation

When mounting a soft starter, or any other equipment which generates heat, into a vented enclosure there must be sufficient airflow through the enclosure to prevent excessive heat build up within the enclosure.

Soft starters dissipate approximately 4.5 watts per line amp. The following table shows the airflow required to limit internal temperature rise of an enclosure housing a soft starter to +5°C or +10°C.

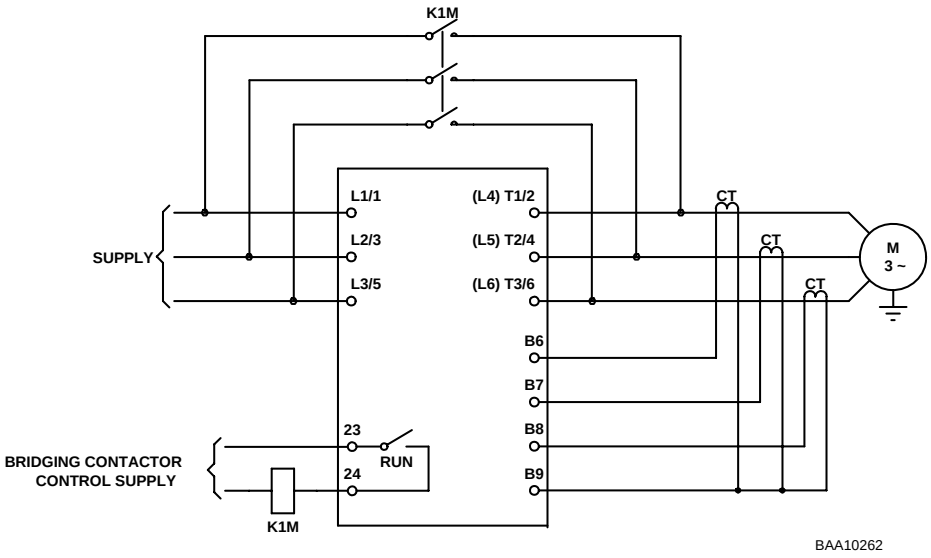
Where additional heat sources (contactors, cables, isolators etc.) are also housed in the enclosure, airflow will need to be increased accordingly.

MOTOR AMPS	HEAT DISSIPATION (@ 4.5 watts / Amp)	Airflow m^3/minute For:	
		5°C Rise	10°C Rise
125	563	5.6	2.8
150	675	6.8	3.4
175	788	7.9	3.9
200	900	9.0	4.5
250	1125	11.3	5.6
300	1350	13.5	6.8
350	1575	15.8	7.9
400	1800	18.0	9.0
450	2025	20.3	10.1
500	2250	22.5	11.3
550	2475	24.8	12.4
600	2700	27.0	13.5

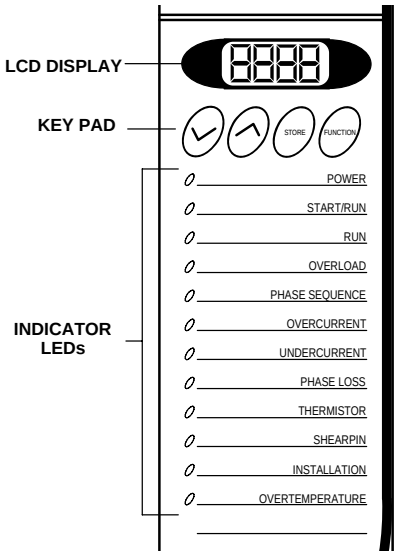
Mounting In Non-ventilated Enclosures

If the EMX2 is to be mounted in a non-ventilated enclosure a bridging contactor should be employed to eliminate heat build up in the enclosure. The Bridging contactor can be AC1 rated as it only carries the running current of the motor.

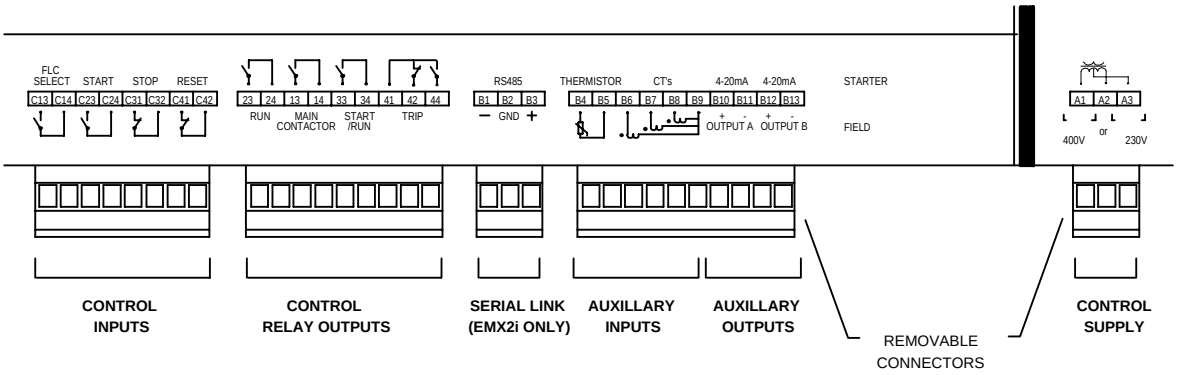
The bridging contactor should be controlled by the EMX2 Run output (23,24) and used to bridge out the SCRs once the motor has started by bridging between:
L1-T1, L2-T2, L3-T3 or L1-L4, L2-L5, L3-L6 or 1-2, 3-4, 5-6



Front Panel Display



Control Terminations


FLC
SELECT
START
STOP
RESET
C13 C14 C23 C24 C31 C32 C41 C42
23 24 13 14 33 34 41 42 44
RUN
MAIN
CONTACTOR
START
/RUN
TRIP
RS485
B1 B2 B3
GND
THERMISTOR
CT's
4-20mA
4-20mA
B4 B5 B6 B7 B8 B9 B10 B11 B12 B13
OUTPUT A
OUTPUT B
STARTER
FIELD
A1 A2 A3
400V
or
230V
CONTROL INPUTS
CONTROL RELAY OUTPUTS
SERIAL LINK (EMX2i ONLY)
AUXILLARY INPUTS
AUXILLARY OUTPUTS
REMOVABLE CONNECTORS
CONTROL SUPPLY

SECTION 6 ELECTRICAL CONNECTION (POWER CIRCUIT)

Overview : This section details the installation of the EMX2 Current Transformers, as well as the various power circuit configurations possible with the EMX2 Series Starters.

Content :

EMX2 Current Transformer Installation 6-1
Motor Connection
- 3 Wire Motor Connection 6-3
- 6 Wire Motor Connection 6-3
Line Contactors 6-4
Semiconductor Fuses 6-4
Bridging Contactors 6-5
Power Factor Correction 6-5
Dual Speed Motors 6-6

Current Transformer Installation & Connection

The EMX2 comes complete with three Current Transformers (supplied loose) details of which are shown on the Application Data Sheet on page 1 of this Users Manual. These CTs must be installed to measure motor (line) current, and the CTs secondaries wired back to the EMX2 unit.

The CTs form part of the feedback loop used by the EMX2 to control and protect the motor, and have been selected specifically for the application for which the starter is supplied. No alternate CTs should be used without reference to the local supplier and appropriate alteration of the EMX2 CT Primary Current Rating parameter (Function 13).

The CT's are supplied separate from the main unit so that the EMX2 can continue to provide protection even when by-passed. This eliminates the need for separate overload protection when a by-pass system is used.

The CTs must be used in a manner that they monitor line current to the motor. They must not be bridged out by a bridging contactor, if used, and they must not be installed inside the delta loop if using six wire connection.

The CTs must be wired back to the EMX2 CT input terminals (B6,B7,B8,B9), ensuring that the common connection is made to terminal No 33. Do not connect any other circuits to the EMX2 CTs. Do not earth the CTs.

FUNCTION 13	CT PRIMARY CURRENT RATING
Description	Sets the value of the primary current of the EMX2 current transformers. Note : the CTs must have 5Amp secondary
Display Units	Amps
Factory Setting	Appropriate for the CTs supplied with the EMX2. Refer Application Data Sheet On Page 1 of this Manual.

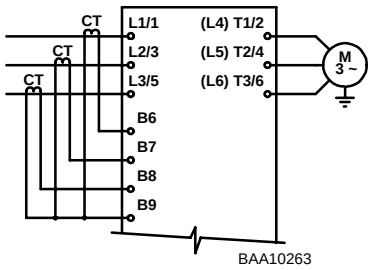
Field Calibration Of Current Monitoring Circuit

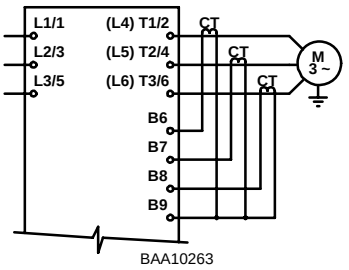
If desired, the EMX2 current monitoring cirucitry can be field calibrated to account for individual component tolerances by measuring the motor running current with a certified calibrated amp meter, and comparing it with the current displayed on the EMX2 current display.

The EMX2 can then be calibrated by adjusting Function 13 according to the following equation:

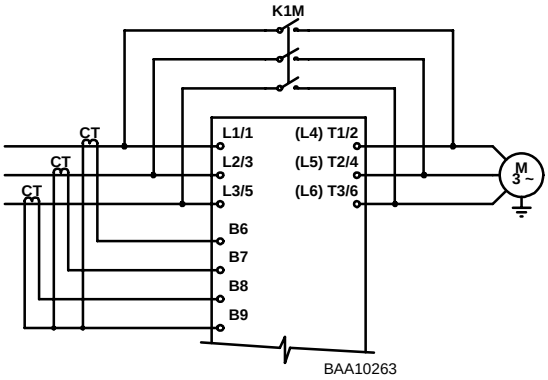
$$\text{CT Primary Setting (Function 13)} = \text{Installed CT Primary Ratio} \times \left(\frac{\text{Measured Current}}{\text{EMX LCD Display Current}} \right)$$

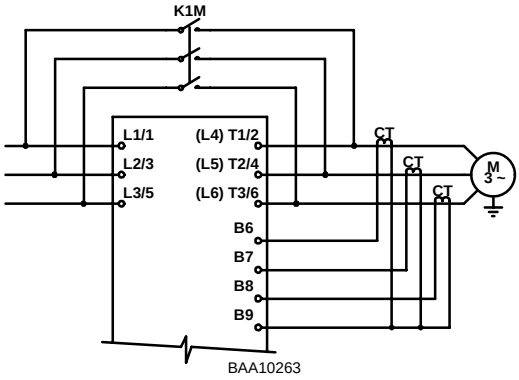
ACCEPTABLE CT POSITIONS (3 Wire - Non By-Passed)



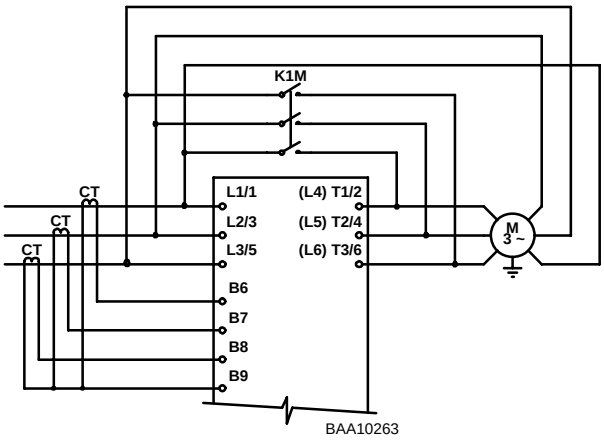


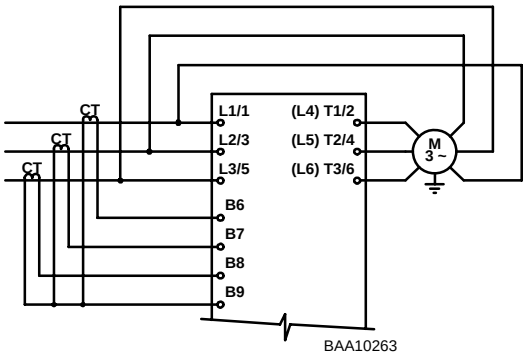
ACCEPTABLE CT POSITIONS (3 Wire -By-Passed)





ACCEPTABLE CT POSITIONS (6 Wire - Non By-Passed & By-passed)





CAUTION

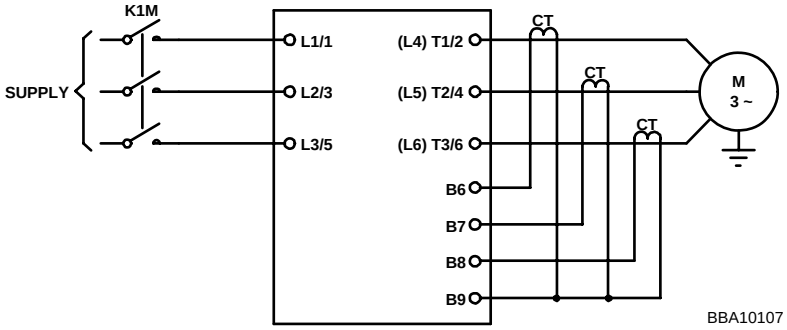
THE EMX2 START PERFORMANCE, DISPLAYED CURRENT READINGS, OVERCURRENT, UNDERCURRENT AND SHEARPIN PROTECTION FUNCTIONS WILL BE INACCURATE UNLESS :

1. **EACH OF THE 3 CTS MONITORS A SEPARATE PHASE**
2. **THE CTS ARE MONITORING LINE CURRENT TO THE MOTOR**
3. **THE EMX2 CT PRIMARY CURRENT RATING PARAMETER (FUNCTION 13) IS SET CORRECTLY FOR THE INSTALLED CTS**
4. **THE CONNECTED CTS HAVE 5 A SECONDARIES**

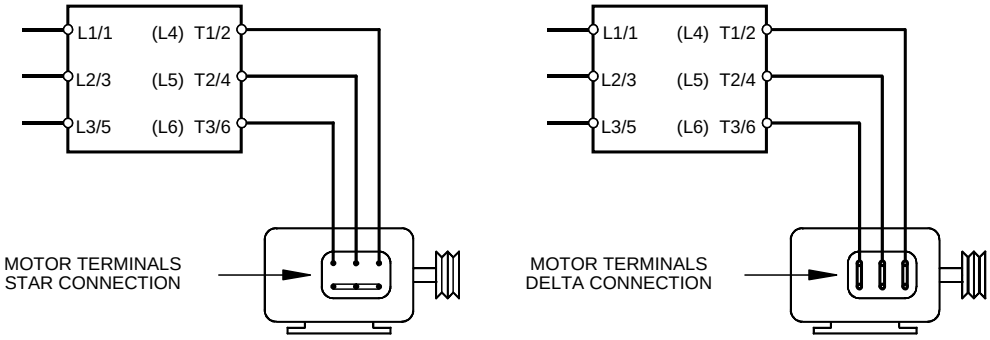
Motor Connection

The EMX2 can be connected to control a variety of different motors in a number of different circuit configurations.

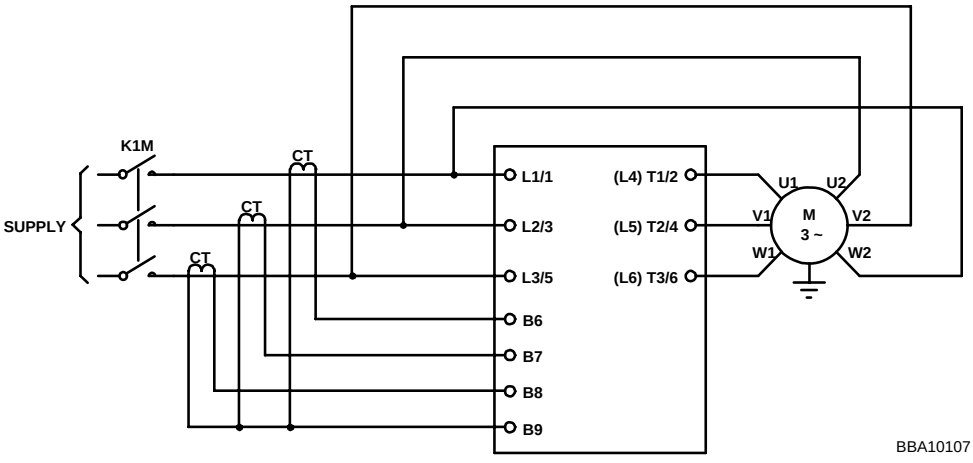
3 Wire Motor Connection



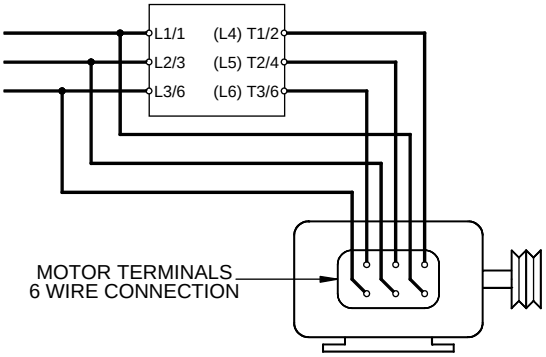
The EMX2 may be connected to motors designed star operation or for motor designed for delta operation, so long as the motor is appropriate for the supply voltage.



6 Wire Motor Connection



Connect the three OUTPUT terminals (T1/2, T2/4, T3/6) of the EMX2 to the motor windings ensuring that the connections are made to one end of each winding only. It is imperative to connect the output of the EMX2 to the same end of each winding and this is usually marked on the motor terminations.



The six terminations to the motor windings are usually arranged in two rows of three so that the links can be fitted across from the top three terminations to the lower terminations. In this case connect the EMX2 to the top terminations only. Connect the other three motor terminals to the input of the EMX2 in a manner that connects the end of each winding to a different phase from the input.

This is easiest achieved by replacing each delta link in the motor terminal box by one phase of the controller.

For example if the delta links are fitted U1-V2,V1-W2,W1-U2

- Connect the incoming phases to L1/1,L2/3,L3/5 on the EMX2.
- Connect the EMX2's to the motor. T1/2-U1, T2/4-V1, T3/6-W1
- Connect the other motor terminals to the EMX2's input. V2-L1/1, W2-L2/3, U2-L3/5

CAUTION

SIX WIRE CONNECTION SHOULD NOT BE MADE WITHOUT USE OF A LINE CONTACTOR AS THE MOTOR REMAINS CONNECTED TO THE SUPPLY EVEN WHEN THE STARTER IS SWITCHED OFF

Line Contactors

The EMX2 is designed to operate with or without a line contactor. In many regions there is a statutory requirement that a line contactor be employed with electronic motor control equipment. From a safety point of view, this is the preferable option, however is not necessary for starter operation. An additional benefit gained by use of a line contactor is isolation of the starter SCR's in the off state, when they are most susceptable to damage from voltage transients.

The EMX2 can directly control a line contactor via the Main Contactor Control output (13,14).

As an alternative to a line contactor, either a circuit breaker with a no volt release coil operated by the EMX2 trip output (41,42,44), or a motor operated circuit breaker can be considered.

If a motor operated circuit breaker is used as a line contactor, the potential delay between the breaker being told to close and phase power being applied to the EMX2 could cause the EMX2 to trip on installation faults. This can be avoided by closing the motorised breaker directly and using the breakers auxiliary contacts to control the EMX2.

Semiconductor Fuses

Fast acting semiconductor fuses can be used with the EMX2 to reduce the potential of damage to the SCRs from transient overload currents. Refer to your starter supplier for semiconductor fuse selection advice.

Bridging Contactors

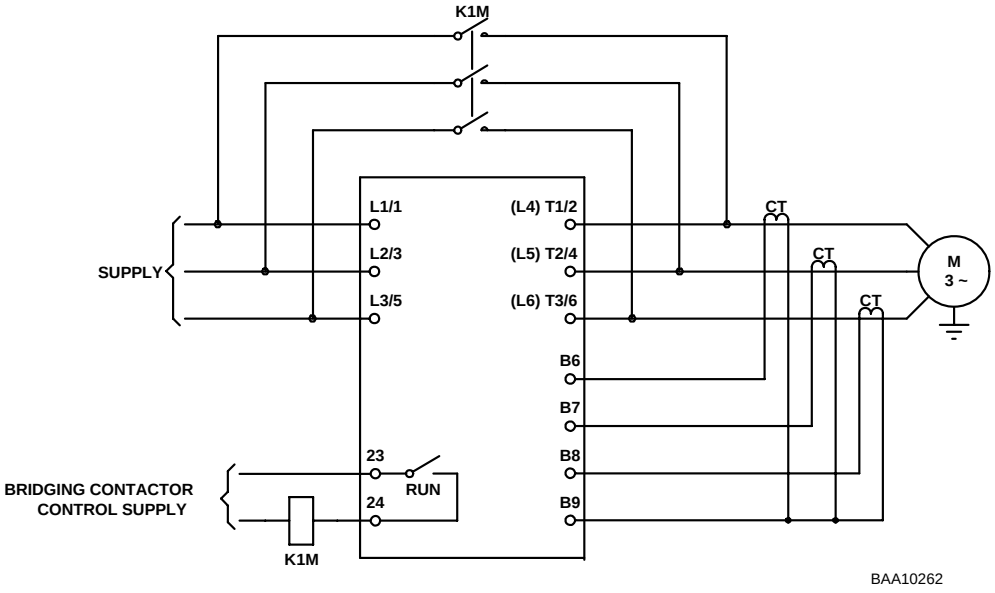
If the EMX2 is to be mounted in a non-ventilated enclosure a bridging contactor should be employed to eliminate heat build up in the enclosure.

Bridging contactor can be AC1 rated as it only carries the running current of the motor.

The bridging contactor should be controlled by the EMX2 Run output (23,24) and used to bridge out the SCRs once the motor has started by bridging between L1/1 - T1/2, L2/3 - T2/4, L3/5 - T3/6.

CAUTION

IT IS IMPERATIVE THAT THE BRIDGING CONTACTOR CONNECTS L1/1 TO T1/2, L2/3 TO T2/4 AND L3/5 TO T3/6. ANY OTHER COMBINATION WILL CAUSE FUSE FAILURE, CIRCUIT BREAKER TRIP AND POSSIBLE SCR FAILURE.



Bridging contactors should be controlled to bridge out the EMX2 during run. The EMX2's bridging contactor control output should be used to control the bridging contactor.

If using a bridging contactor

- Connect between the inputs and outputs of the EMX2 ensuring that with the contactor closed, L1/1 connects to T1/2, L2/3 connects to T2/4 and L3/5 connects to T3/6.
- Connect the coil of the bridging contactor through the EMX2 Run relay outputs to the control voltage.
- To maintain EMX2 motor protection features ensure CT's are installed outside the by-pass circuit.

Power Factor Correction

If static power factor correction is employed, it must be connected to the supply side of the soft starter.

CAUTION

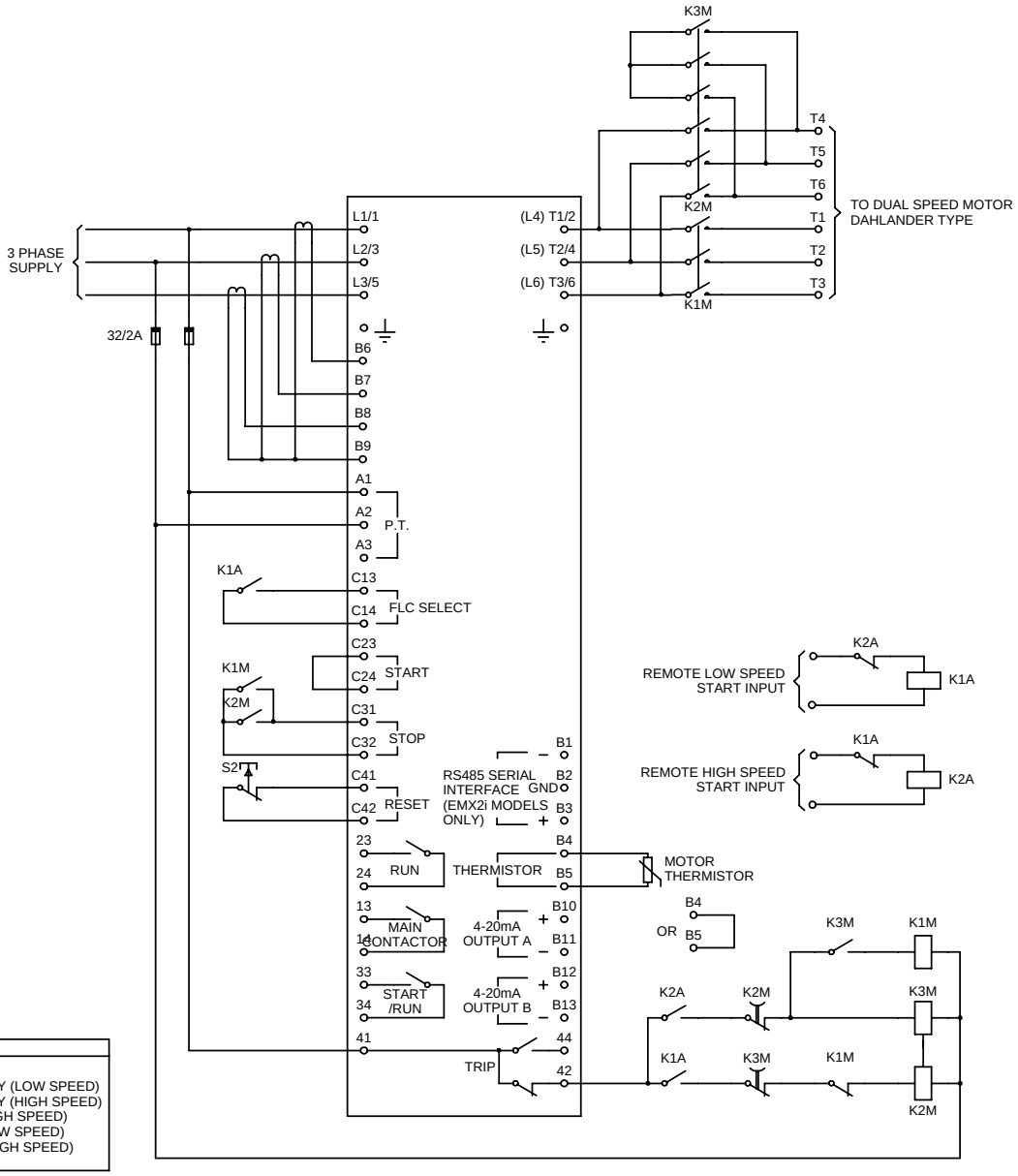
UNDER NO CIRCUMSTANCE SHOULD POWER FACTOR CORRECTION CAPACITORS BE CONNECTED BETWEEN THE SOFT STARTER AND THE MOTOR.

Dual Speed Motors

Dahlander Two Speed motor applications are specifically catered for by the EMX2 starters, which includes dual parameter settings to allow individual start and protection parameters to be programmed for each motor speed. The Dahlander speed changeover contactors should be connected to the output of the EMX2. Refer Application Schematic below.

The secondary start and protection parameters (Functions 21 > 29) are operational when the FLC Select terminals (C13,C14) are linked. To switch between primary and secondary parameter settings the EMX2 must be stopped, the FLC Select contact operated, and the EMX2 restarted. (Refer Typical Application 4).

Secondary settings are programmed and operate in an identical manner to the primary setting.



LEGEND	
A1	EMX2
K1A	REMOTE START RELAY (LOW SPEED)
K2A	REMOTE START RELAY (HIGH SPEED)
K1M	LINE CONTACTOR (HIGH SPEED)
K2M	LINE CONTACTOR (LOW SPEED)
K3M	STAR CONTACTOR (HIGH SPEED)
S1	RESET PUSHBUTTON

SECTION 7 ELECTRICAL CONNECTION (CONTROL CIRCUIT)

Overview : This section details the connection of control voltage to the EMX2 Starters as well as describing the EMX2's various control inputs and outputs. Additionally, typical connection schematics are provided.

Content :

EMX2 Electronics Supply 7-1
Control Inputs
- Start 7-2
- Stop 7-2
- Reset 7-2
- FLC Select 7-2
- Emergency Stop 7-2

Control Outputs
- Main Contactor 7-3
- Start/Run 7-4
- Run 7-4
- Trip 7-4

Analogue Outputs
- Motor Current..... 7-5
- Motor Temperature (Thermal Model) 7-5

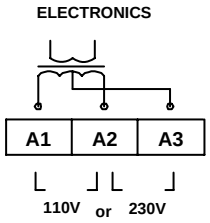
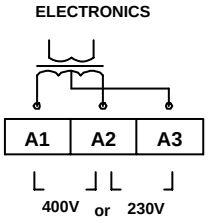
Typical Installation Formats 7-6

EMX2 ELECTRONICS & FAN SUPPLY

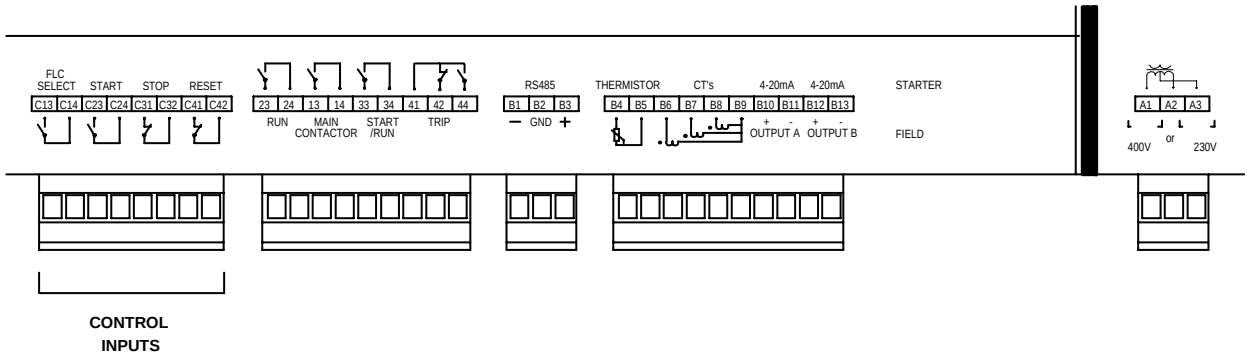
The EMX2 must be supplied with control voltage which controls both the electronics and cooling fans. Refer to labeling on the EMX2 for control voltage options.

The EMX2 is designed to operate with the electronics permanently supplied. The electronics must be powered up for the thermal model to function in the OFF state (motor not running) while the motor is cooling. The electronics must also be powered up so that the EMX2 can control any line contactor connected.

EMX2 CONTROL VOLTAGE

Canada United States of Amercia	All Other Countries
	

Control Inputs The EMX2 incorporates the following control inputs.



Start (C23,C24)

- active 24 VDC
- operate with potential free circuit

  Four Wire Control : The start circuit must be closed fleetingly to start the motor. The start signal is latched internally by the EMX2 until either the starter trips or the stop circuit is opened.

  Two Wire Control : In a two wire non latching circuit the start input is linked and the EMX2 is controlled by closing and opening the stop input.
- contacts used for controlling this input should be low voltage, low current rated. (Gold flash or similar)

Stop (C31,C32)

- active 24 VDC
- operate with potential free circuit. (Must be closed for the EMX2 to operate)
- contacts used for controlling this input should be low voltage, low current rated. (Gold flash or similar)

Reset (C41,C42)

- active 24 VDC
- operate with potential free circuit. (Must be closed for the EMX2 to operate). Open circuit to closed circuit transition resets the EMX2
- contacts used for controlling this input should be low voltage, low current rated. (Gold flash or similar)

FLC Select (C13,C14)

- active 24 VDC
- operate with potential free circuit . An open circuit selects the primary motor parameters and a closed contact selects the secondary parameters. The FLC Select Input is used primarily to select a secondary set of parameters in dual speed motor applications. (Refer Dual Speed Motor section of this manual for further description of FLC Select use).
- contacts used for controlling this input should be low voltage, low current rated. (Gold flash or similar)

EMERGENCY STOP Simultaneously opening the STOP & RESET circuits will effect an immediate stop, and cause the trip relay to operate, and then reset after approximately 8 seconds.

Control Input wiring should be run separately from power wiring to prevent noise and possible induced voltage.

CAUTION

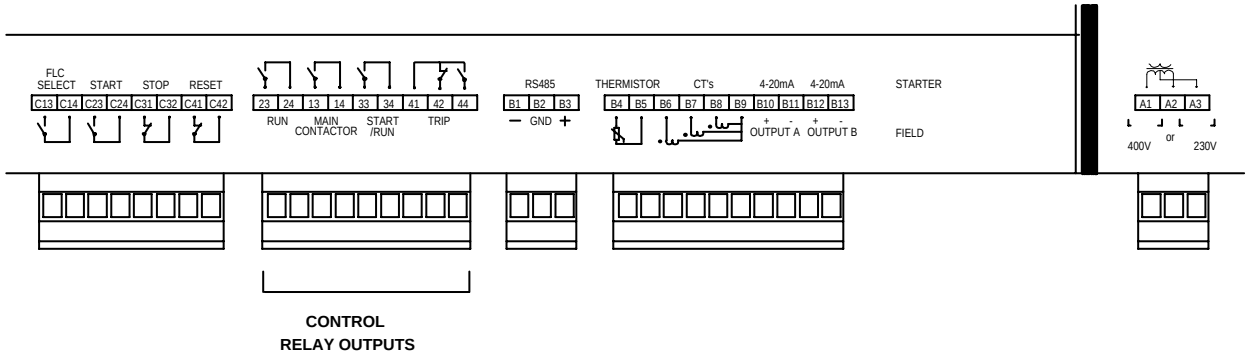
VOLTAGE MUST NOT BE APPLIED TO THE CONTROL INPUT TERMINALS. APPLICATION OF VOLTAGE IS LIKELY TO CAUSE EQUIPMENT DAMAGE.

Operational Overview (Control inputs.)

1) OFF mode.	In the OFF mode, the starter microcomputer monitors the START, STOP, RESET and keypad inputs. a) If the RESET input is open circuit, the EMX2 will ignore all other inputs. b) If the keypad function key is pressed, the starter will enter the programming mode. c) If the STOP, START and RESET are closed, the starter will enter the PRESTART mode. NB. The START input is only monitored in the OFF mode and SOFT STOP mode.
2) PRESTART mode.	In the PRESTART mode, the main contactor is closed, the starter microcomputer executes a number of measurements, and depending on the results of these, either auto configures itself and enters the START mode, or trips on an installation or phase sequence fault.
3) START mode	In the START mode, the starter microcomputer monitors the STOP and RESET. a) If the STOP is open and the RESET is closed, the starter enters the SOFT STOP mode. b) If both the STOP and the RESET are open, the starter will immediately stop and enter the OFF mode. c) If the output voltage from the starter reaches full voltage, the starter will enter the RUN mode.
4) RUN mode	In the RUN mode, the starter microcomputer monitors the STOP and RESET. a) If the STOP is open and the RESET is closed, the starter enters the SOFT STOP mode. b) If both the STOP and the RESET are open, the starter will immediately stop and enter the OFF mode.
5) SOFT STOP mode	In the SOFT STOP mode, the starter microcomputer monitors the START, STOP and RESET. In SOFT STOP mode, the output voltage is reduced at the rate determined by the stop time parameter. (soft stop) a) If the stop time parameter is zero, the starter immediately enters the OFF mode. b) If both the STOP and the RESET are open, the starter will immediately stop and enter the OFF mode. c) If the START and STOP are closed, the starter enters the START mode. d) As the output voltage approaches zero, the starter enters OFF mode.
6) TRIP mode	In the TRIP mode, the starter microcomputer monitors the RESET input. In TRIP mode, SCR conduction is inhibited. a) If the RESET is closed, the starter enters the OFF mode.

Control Outputs

The EMX2 incorporates the following control outputs



Main Contactor (13,14)

- Potential Free, Normally Open Relay Contact
- closes when the EMX2 receives start signal, opens when EMX2 stops applying voltage to the motor and when the EMX2 Trips
- designed to control operation of a line contactor if fitted to the input of the EMX2. This function is particularly useful when utilising the Soft Stop function and a line contactor, as it closes the contactor on start and opens the contactor at the end of the ramp down period.

Start/Run (33,34)

- Potential Free, Normally Open Relay Contact
- closes when the EMX2 is in either the start mode, run mode or soft stop mode. ie closed when the starter is expected to be applying voltage to the motor.

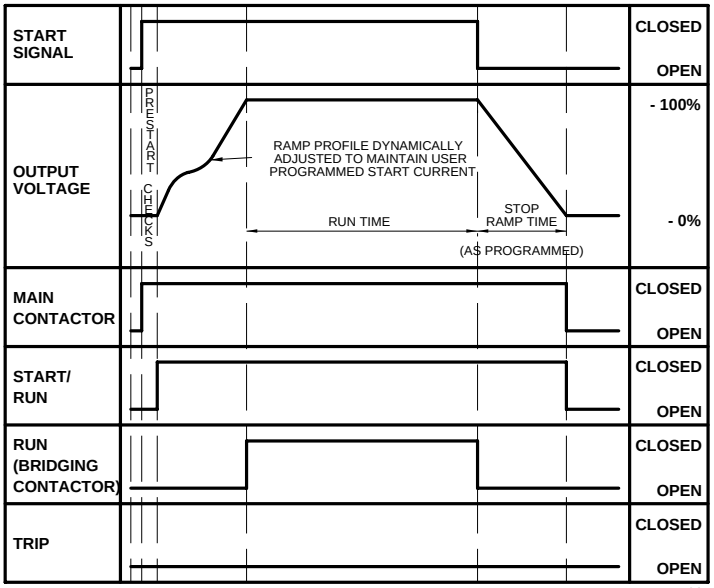
Run (23,24)

- Potential Free, Normally Open Relay Contact
- closes when EMX2 is applying line voltage to the motor.
- designed to control a bridging contactor, if fitted, and/or as an Off-Load control output for compressors, conveyors, pumps etc.

Trip (41,42,44)

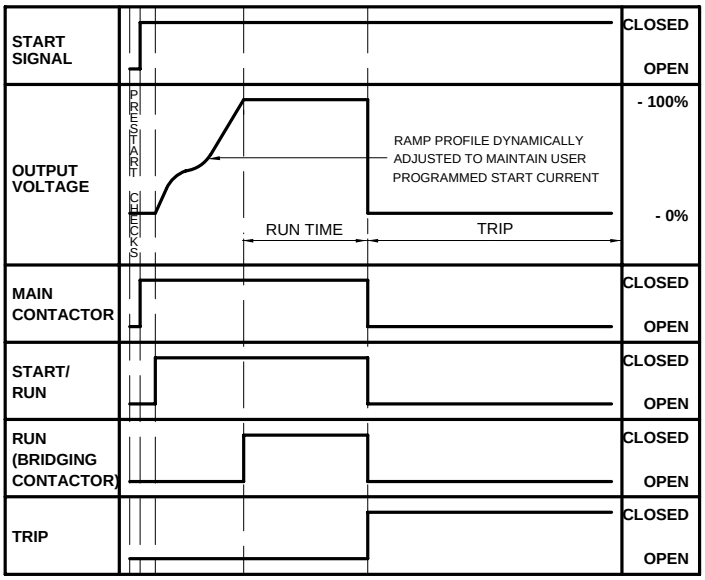
- Potential Free, Changeover Relay Contacts
- Changes state when the EMX2 is in the tripped state.

Relay Operation : Normal Running



BAA10258

Relay Operation : Trip



BAA10259

Starter Operation (Relay outputs.)

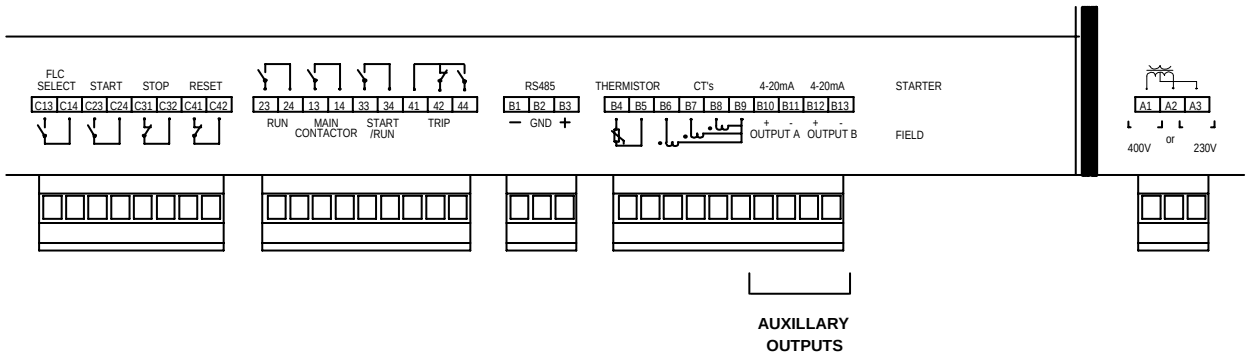
1) OFF mode.	In the OFF mode, the Main Contactor, Start/Run and Run relay outputs are in their normally open state and the trip relay is in the normal state also.
2) PRESTART mode.	In the PRESTART mode, the main contactor is closed, the starter microcomputer executes a number of measurements, and depending on the results of these, either auto configures itself and enters the START mode, or trips on an installation or phase sequence fault.
3) START mode	In START mode, the main contactor is closed, and the start/run is closed. a) If the output voltage from the starter reaches full voltage, the starter will enter the RUN mode.
4) RUN mode	In RUN mode, the main contactor is closed, the start/run is closed and the run is closed.
5) SOFT STOP mode	In SOFT STOP mode, the run contact is open. The start/run and main contactor are closed. The output voltage is reduced at the rate determined by the stop time parameter. (soft stop) a) If the stop time is zero, the starter immediately enters the OFF mode. b) As the output voltage approaches zero, the starter enters OFF mode.
6) TRIP mode	In TRIP mode, the main contactor, run and start/run contacts are open and the trip relay changes state. SCR conduction is inhibited. a) If the RESET is closed, the starter enters the OFF mode.

Analogue Outputs

Two 4 - 20mA analogue outputs are provided by EMX2, for interface of :

- Motor Current
- Motor Temperature

These outputs are useful for load control, remote panel meters etc.



% Motor Current (B10,B11)

- 4-20mA Signal, B10(+),B11(-) (Output A)
- Indicates the average current being drawn by the motor as a percentage of Full Load Current (4mA = 0% 20mA = 125%)

Motor Temperature (Thermal Model) (B12,B13)

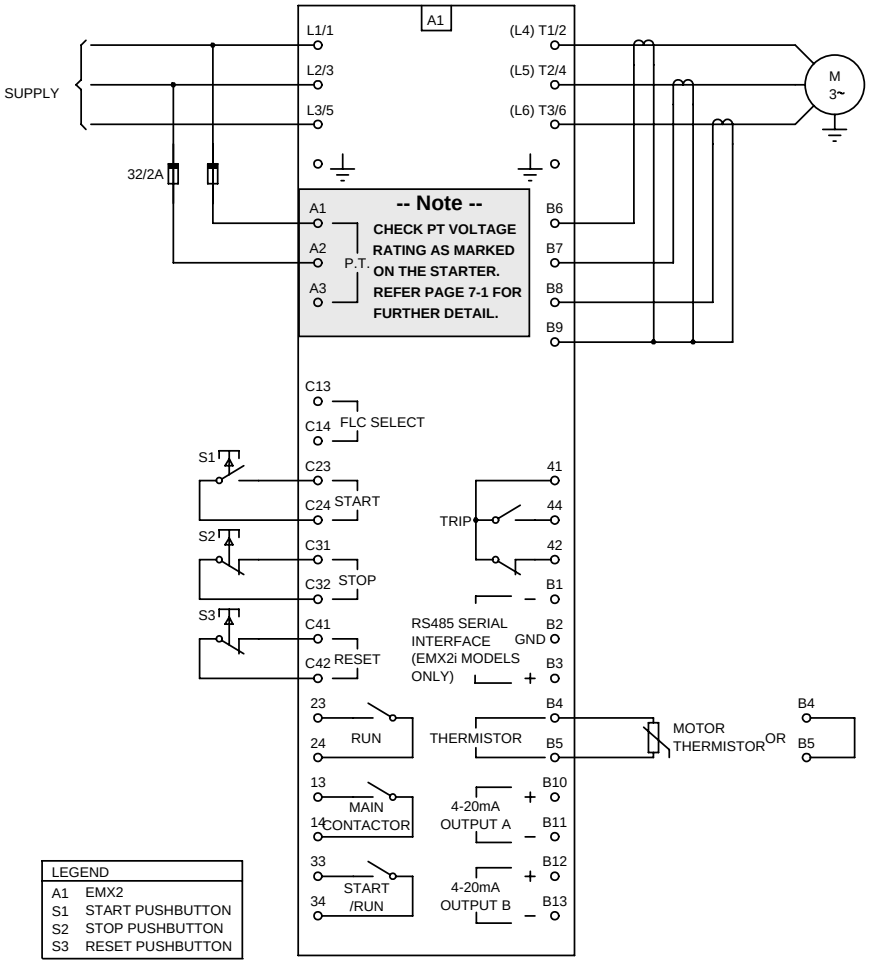
- 4-20mA Signal, B12(+),B13(-) (Output B)
- Indicates the modelled motor temperature as a percentage of the trip temperature. The thermal model is tailored by the Motor Start Time Constant (Function 6). (4mA = 0% 20mA = 105%). The EMX2 trips at 105%.

Typical Installation Formats

The EMX2 Series starters may be connected and controlled in a wide variety of ways. Five common application formats are detailed in the following application examples.

If none of these options fully meets application requirements further study of this Users Manual should enable custom design of an appropriate circuit.

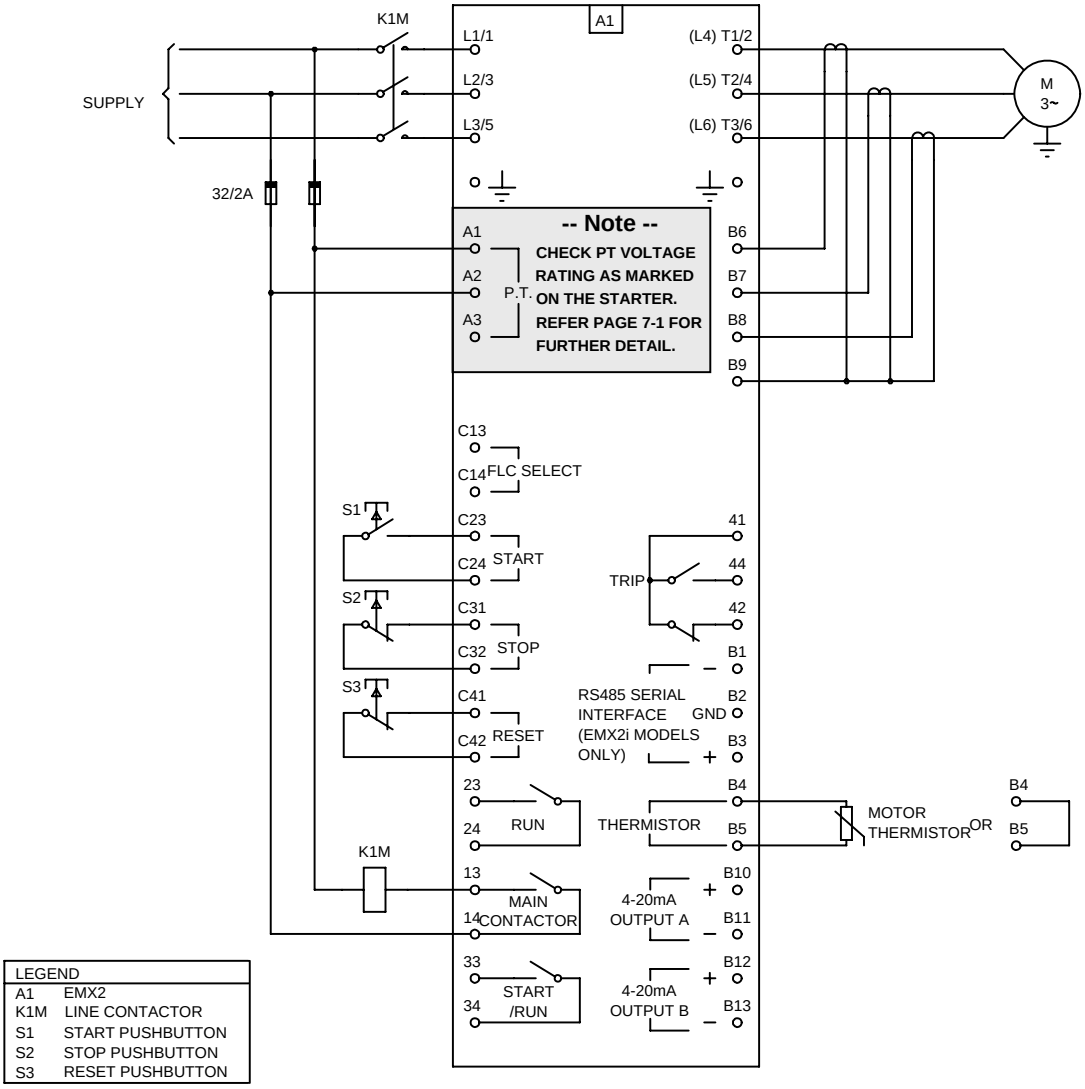
APPLICATIONS 1: A typical application where the EMX2 is applied without a line contactor, and is controlled by start/stop push buttons.(Ensure local regulations and by-laws permit operation of electronic soft starters without a line contactor or similar load break switch).



INSTALLATION PROCEDURE

1. Connect the EMX2 (L1/1, L2/3, L3/5) to the supply and EMX2 Outputs (T1/2,T2/4,T3/6) to the motor using appropriate fuses and isolator. Ensure the CTs supplied with the EMX2 are installed on separate phases and monitor line current.
2. Connect the EMX2 CT secondaries to the EMX2 CT terminals (B6,B7,B8,B9) ensuring that the common connection is made to terminal B9.
3. Connect control voltage (400V) to the EMX2 electronic supply. (Terminals A1 & A2).
4. Connect motor thermistors to EMX2 Thermistor input (Terminals B4,B5), If motor thermistors are not connected ensure that the Thermistor Input is linked.
5. Connect START, STOP & RESET circuits.
6. Commission the EMX2 by following the steps outlined in the Commissioning Procedure section of this Users Manual.

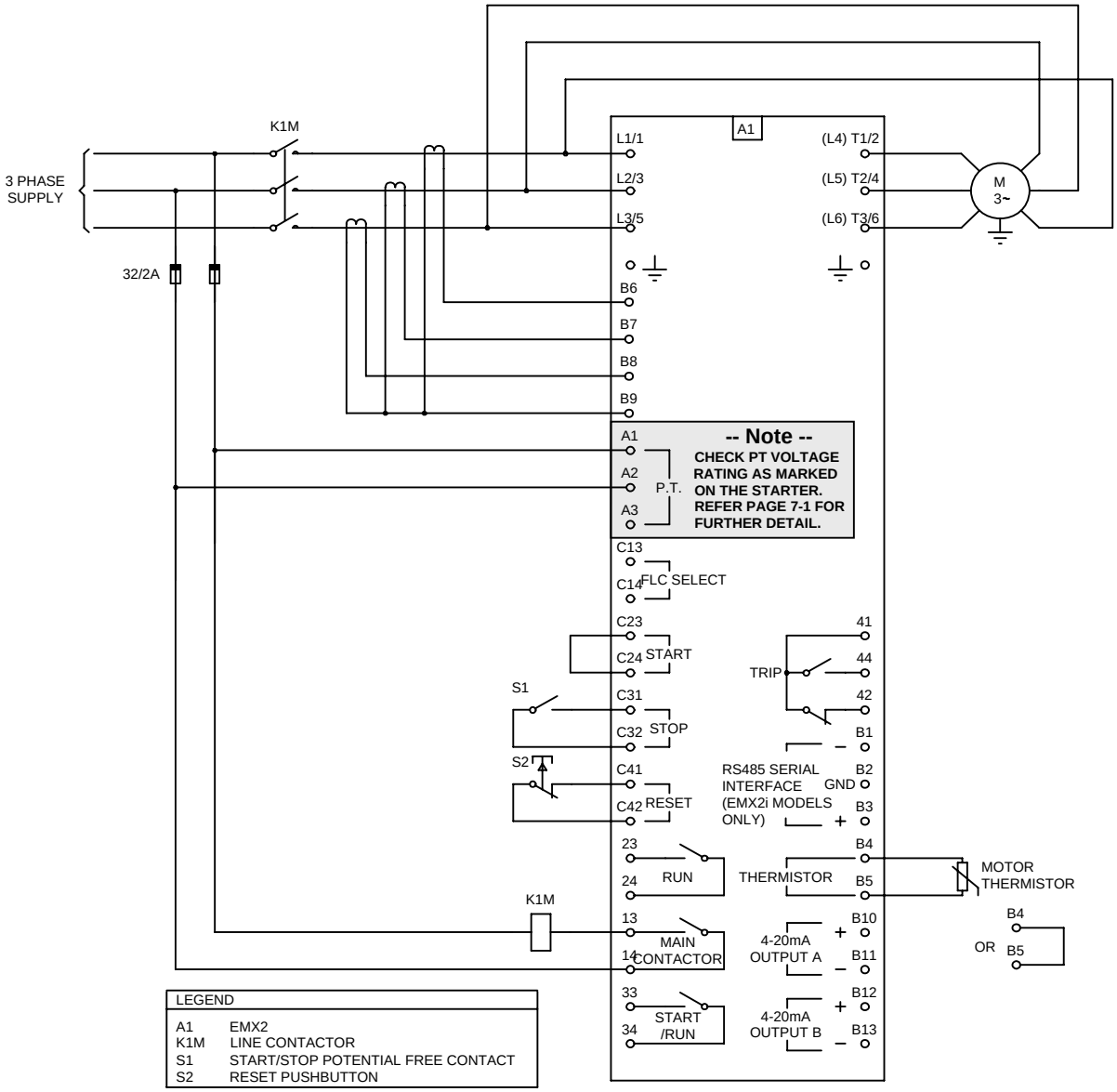
APPLICATIONS 2: A typical application where the EMX2, controlled directly via push buttons, is used to control line contactor (K1M) operation.



INSTALLATION PROCEDURE

1. Install the EMX2 between the Line Contactor and the motor, by connecting the output of the contactor to the EMX2 input terminals (L1/1, L2/3, L3/5), and connecting the motor to the EMX2 output terminals (T1/2,T2/4,T3/6).
2. Connect the EMX2 CT secondaries to the EMX2 CT terminals (B6,B7,B8,B9) ensuring that the common connection is made to terminal B9.
3. Connect control voltage (400V) to the EMX2 electronic supply. (Terminals A1 & A2). The control supply must be sourced from the line side of the contactor so that the EMX2 is able to control the line contactor and provide continuous thermal modelling.
4. Connect motor thermistors to EMX2 Thermistor input (Terminals B4,B5), If motor thermistors are not connected ensure that the Thermistor Input is linked.
5. Connect START, STOP & RESET circuits.
6. Wire the coil of the line contactor through the Main Contactor relay output as shown.
7. Commission the EMX2 by following the steps outlined in the Commissioning Procedure section of this Users Manual.

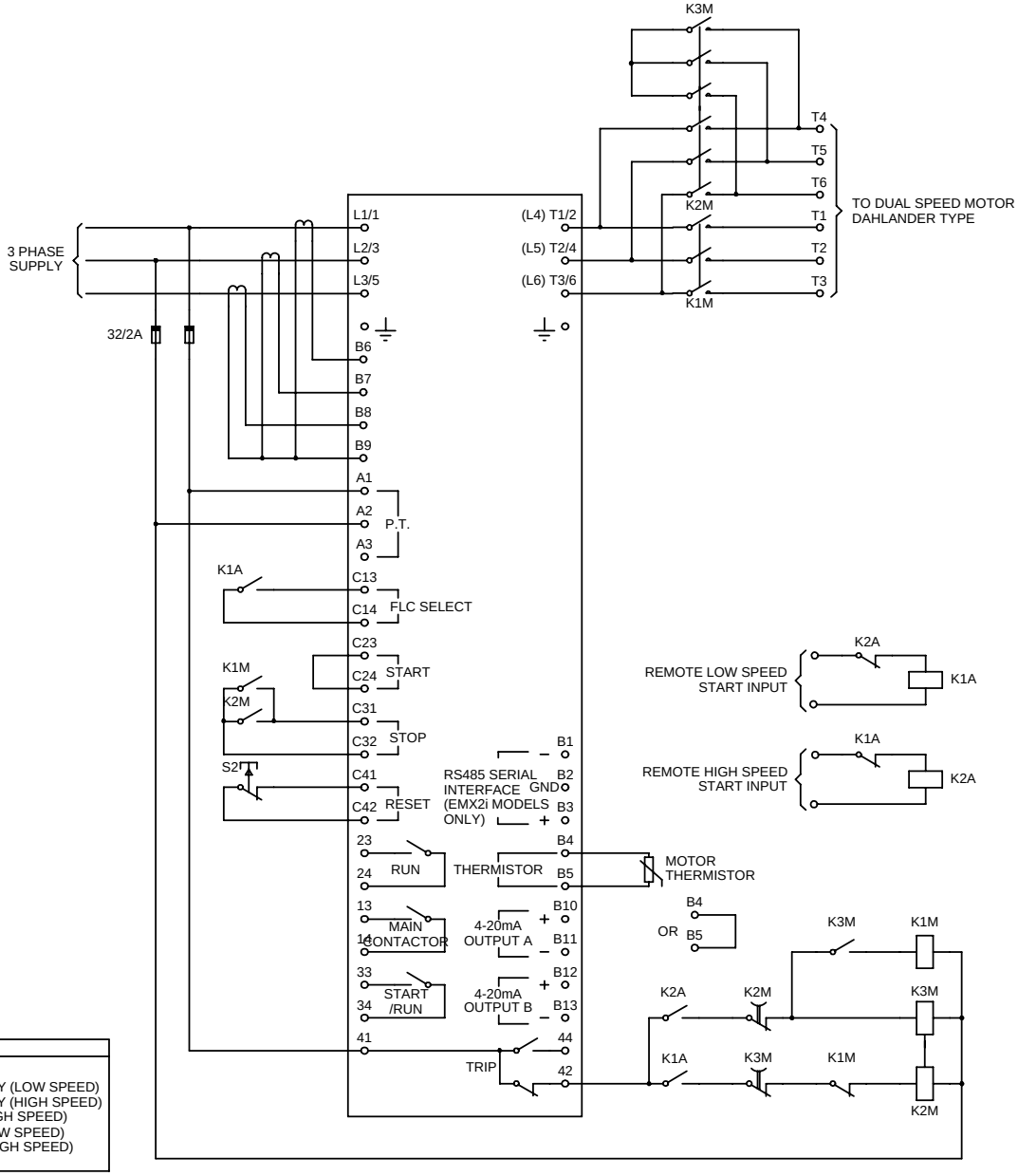
APPLICATIONS 3: A typical application where the EMX2, connected in six wire configuration, and controlled directly via an automatic two wire potential free contact, is used to control line contactor (K1M) operation.



INSTALLATION PROCEDURE

1. Connect the motor to the EMX2 and supply as shown.
   - Connect the incoming phases to L1/1,L2/3,L3/5 on the EMX2.
   - Connect the EMX2 to the motor. T1/2-U1, T2/4-V1, T3/6-W1
   - Connect the other motor terminals to the EMX2 input. V2-L1/1, W2-L2/3, U2-L3/5
2. Install the CTs supplied with the EMX2 ensuring that they are installed on separate phases and that they monitor line current. (Installing the CTs within the delta circuit will invalidate EMX2 starting and protection functions)
3. Connect the EMX2 CT secondaries to the EMX2 CT terminals (B6,B7,B8,B9) ensuring that the common connection is made to terminal B9.
4. Connect control voltage (400V) to the EMX2 electronic supply. (Terminals A1 & A2). The control supply must be sourced from the line side of the contactor so that the EMX2 is able to control the line contactor and provide continuous thermal modelling.
5. Connect motor thermistors to EMX2 Thermistor input (Terminals B4,B5), If motor thermistors are not connected ensure that the Thermistor Input is linked.
6. Connect START, STOP & RESET circuits.
7. Wire the coil of the line contactor through the Main Contactor relay output as shown.
8. Commission the EMX2 by following the steps outlined in the Commissioning Procedure section of this Users Manual.

APPLICATIONS 4: A typical application where the EMX2, connected controlled directly via an automatic two wire potential free contact, is used to control a dual speed motor. This circuit is NOT appropriate for applications requiring Soft Stop.

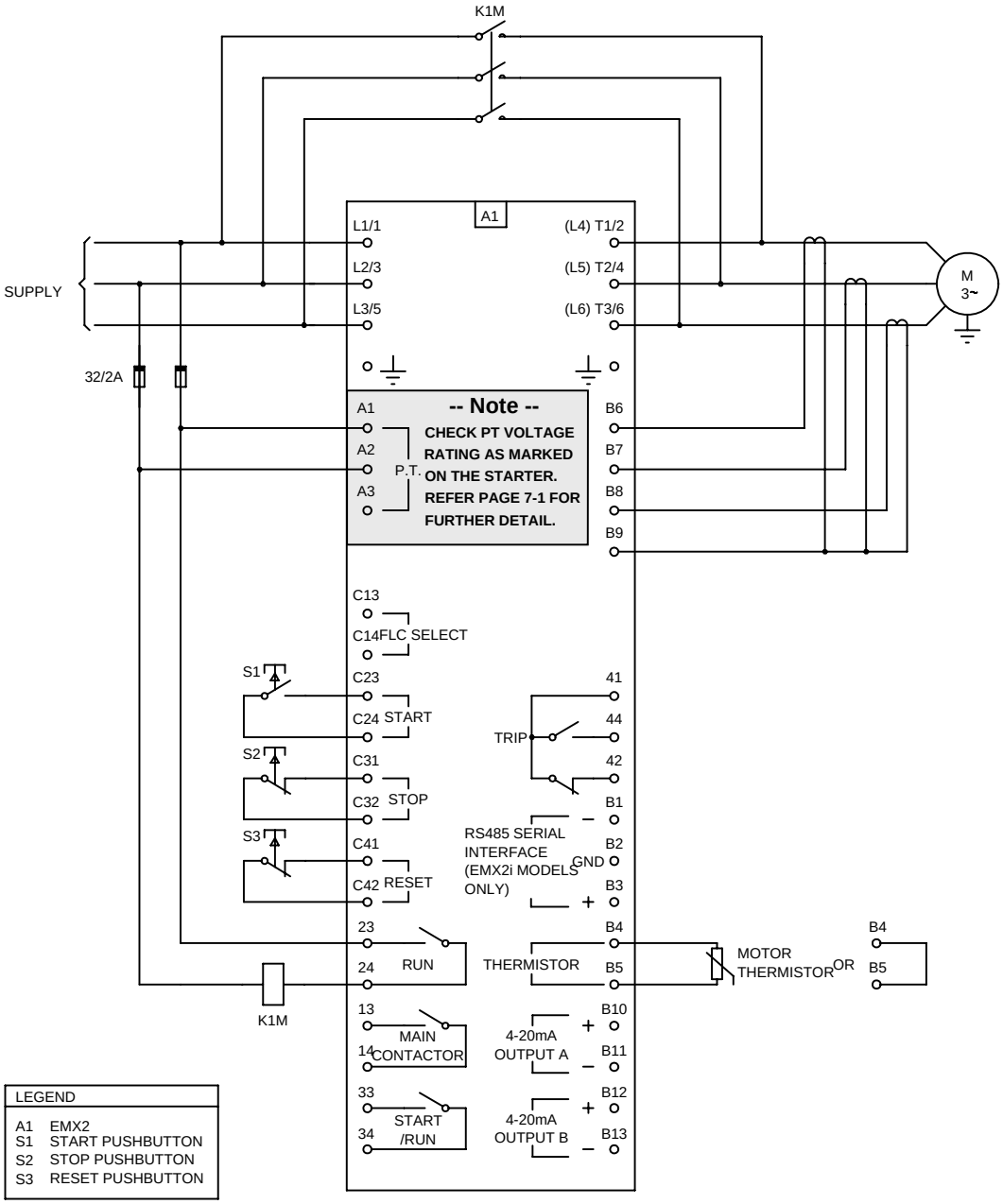


LEGEND	
A1	EMX2
K1A	REMOTE START RELAY (LOW SPEED)
K2A	REMOTE START RELAY (HIGH SPEED)
K1M	LINE CONTACTOR (HIGH SPEED)
K2M	LINE CONTACTOR (LOW SPEED)
K3M	STAR CONTACTOR (HIGH SPEED)
S1	RESET PUSHBUTTON

INSTALLATION PROCEDURE

1. Connect the EMX2(L1/1, L2/3, L3/5) to the supply and EMX2 Outputs (T1/2,T2/4,T3/6) to the Dahlander speed changeover contactors as shown. Ensure the mechanical and electrical interlocks, and delay contacts are as shown. Also ensure the CTs supplied with the EMX2 are installed on separate phases and monitor line current.
2. Connect the EMX2 CT secondaries to the EMX2 CT terminals (B6,B7,B8,B9) ensuring that the common connection is made to terminal B9.
3. Connect control voltage (400V) to the EMX2 electronic supply. (Terminals A1 & A2).
4. Connect motor thermistors to EMX2 Thermistor input (Terminals B4,B5), If motor thermistors are not connected ensure that the Thermistor Input is linked.
5. Connect control circuitry as shown.
6. Commission the EMX2 by following the steps outlined in the Commissioning Procedure section of this Users Manual.

APPLICATIONS 5: A typical application where the EMX2, connected controlled by start/stop push buttons, is by-passed during run. (Ensure local regulations and by-laws permit operation of electronic soft starters without a line contactor or similar load break switch).



INSTALLATION PROCEDURE

1. Connect the EMX2(L1/1, L2/3, L3/5) to the supply and EMX2 Outputs (T1/2,T2/4,T3/6) to the motor. Ensure the CTs supplied with the EMX2 are installed on separate phases, monitor line current and are not by-passed by the bridging contactor.
2. Connect the bridging contactor to by-pass the EMX2(but not EMX2 CTs), as shown.
3. Connect the EMX2 CT secondaries to the EMX2 CT terminals (B6,B7,B8,B9) ensuring that the common connection is made to terminal B9.
4. Connect control voltage (400V) to the EMX2 electronic supply. (Terminals A1 & A2).
5. Connect motor thermistors to EMX2 Thermistor input (Terminals B4,B5), If motor thermistors are not connected ensure that the Thermistor Input is linked.
6. Connect START, STOP & RESET circuits.
7. Commission the EMX2 by following the steps outlined in the Commissioning Procedure section of this Users Manual.

SECTION 8 COMMISSIONING PROCEDURE

Overview : This section details commissioning procedures for an EMX2 installation.

Content :
Pre-commissioning Checks 8-1
Commissioning Procedure 8-2
Post-commissioning Recording 8-3

Pre-commissioning Checks

STEP	CHECK
1	Ensure that the correct model has been supplied as ordered for the application.
2	Verify that the EMX2 serial number shown on the Application Data Sheet on page 1 of this manual sheet matches the serial number on the unit.
3	Verify that the quoted start parameters are suitable for the application.
4	Check the C.T.s supplied and/or fitted and ensure that they are equal to the ratio specified on the Application Data Sheet on page 1 of this manual.
5	Inspect the starter and report any visible signs of damage to the unit.
6	Verify that the control circuit is a) suitable for the application b) compatible with the EMX2 control philosophy.
7	Cooling of the EMX2 is important for the long term reliability of the product and for the elimination of over temperature trips. Ensure that the ventilation is appropriate for the application. If the EMX2 is not bypassed during run, ensure that there is provision for sufficient passage of air out of the enclosure to cool the unit. This may require forced ventilation of the enclosure.
8	Check that the Electronics & Fan PT input is connected to a control supply, using either terminals A1 and A2, or A2 and A3. NB Only two terminals are to be connected!
9	Apply power to the Electronics PT input, and ensure that the POWER LED on the control panel illuminates.
10	Following the "Read Parameter" procedures, step through all the parameters 1 - 30 checking them against the Factory Settings.
11	Study the parameters and verify that each parameter is appropriate for the application. Change any parameters which need to be altered and record the new settings.
12	Program the new settings into the EMX2 following the "Save Parameter" procedures.

Commissioning Procedure

STEP	CHECK
1	Ensure the enclosure is free of metallic swarf and wire offcuts.
2	Before connecting the output terminals to the motor, carry out an insulation test of the motor windings to earth. The reading should be in excess of 10 Megohms. If practical, an insulation test between windings should also be carried out.
3	Connect the output terminals to the motor.
4	Ensure that all the main power terminations are tight.
5	Ensure that the voltage applied to the isolator is correct and that all three phases are present.
6	Ensure that the incoming supply is connected to L1/1, L2/3 and L3/5.
7	If the EMX2 is installed with a bypass contactor, ensure that the contactor is bypassing the appropriate terminals on the EMX2. L1/1 must connect via the bypass contactor to T1/2, L2/3 must connect via the contactor to T2/4, and L3/5 must connect via the contactor to T3/6. If the EMX2 is incorrectly bypassed, damage to the starter can result and supply fuses fail or circuit breaker will open.
8	Ensure that the START input to the EMX2 is open circuit. This will ensure that the EMX2 can not start while other test are carried out.
9	Apply the control supply to the EMX2, and ensure that all fans are running freely and the POWER LED is illuminated.
10	Check the status of all the control inputs by measuring the voltage across them. The STOP and RESET should show zero volts if closed. If two wire control is employed, then the STOP input should be open and have a terminal voltage of between 12 and 24 VDC. The FLC selector input should be open and measure 12 - 24 VDC.
11	Connect an ammeter in the circuit to display the current during start. A sufficiently rated Clamp type meter would be satisfactory, or a clamp meter on a CT output could be used.
12	Calculate the expected start current from the parameters programmed into the EMX2. [Current Limit (%) (Function 2) x Motor Full Load Current (A) (Function 1)]
13	Ensure that the motor, couplings and machine are ready for an attempted start.
14	Start the motor using the EMX2 and monitor the start current and the direction of rotation. If the direction of rotation is incorrect, stop the machine, isolate the starter and swap two phases on the input or the output of the starter. If the measured start current does not match the calculated start current, stop the motor and check the CT wiring, CT ratio and the parameters set in the starter.
15	Compare the measured current with the current displayed on the EMX2 display. If the display is incorrect, check the CT wiring, CT ratio and the parameters set in the starter.
16	If the motor does not start easily and appears to "run out of start torque", check that the load is correctly matched to the motor, and provided the starter is appropriately rated, increase the start current and/or current limit parameters in the EMX2. If the motor starts very easily, it may be possible to achieve a good start at a reduced start current. This may be desirable in some installations to reduce supply disturbances or acceleration rates.

STEP	CHECK
17	If a Bypass contactor is employed, ensure that it closes once the motor has reached full speed and the start current has fallen. Once the bypass contactor has closed, ensure that the EMX2 displays the correct current. If the Bypass contactor bridges out the CTs as well as the SCRs, the current will read close to zero.
18	Ensure that the motor and machine operate satisfactorily without nuisance tripping. It may be necessary to trim the undercurrent, Shearpin and phase imbalance protection parameters.

Post Commissioning Recording

STEP	CHECK
1	Record function setting on the Application Data Sheet form on page 1 of this users manual and file the Users Manual in an appropriate location for future reference.

SECTION 9 EMX2 PROGRAMMING PROCEDURE

Overview : This section provides instruction on the use of the EMX2 Data Entry Key Pad and details adjustment of EMX2 user programmable functions.

Content :

Overview of EMX2 Function Set 9-1
Function List 9-2
Programming Procedure 9-3
- Read Parameters 9-4
- Program Parameters 9-5
Function Adjustment Chart 9-6

Overview of EMX2 Function Set

The EMX2 has four parameter categories, each accessable from the Front Panel Display :

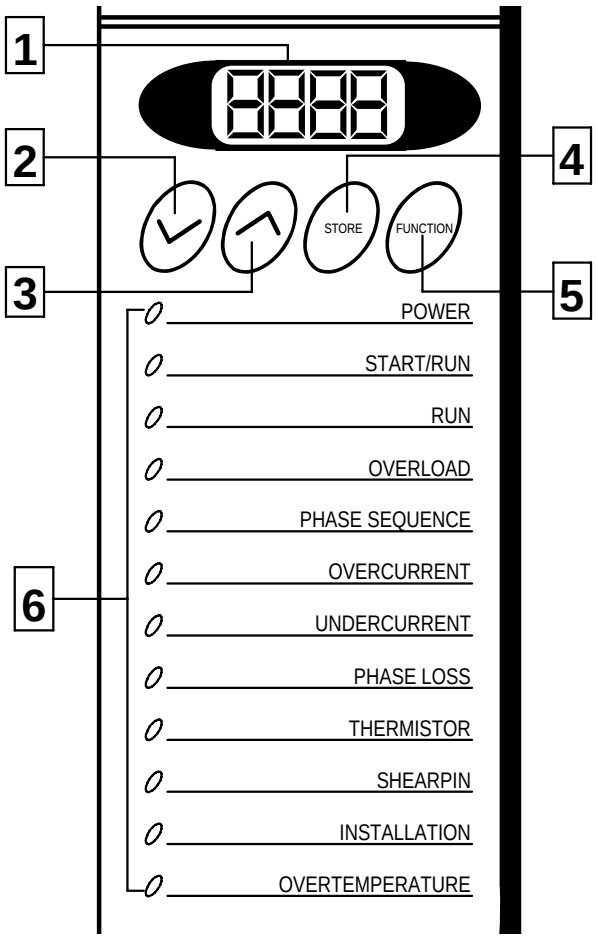
1. **Primary Motor Settings** : parameters/set points for use with to single speed motors or the primary motor speed in dual speed motor applications. The Primary Motor Settings are User Programmanble and are activated by an open circuit on the FLC SELECT input (terminals C13,C14).
2. **Secondary Motor Settings** : parameters/set points for use with the secondary motor speed in dual speed applications, or for dual parameter settings in special applications. The Secondary Motor Settings are User Programmable and are activated by a closed circuit on the FLC SELECT input (terminals C13,C14).
3. **Common Settings** : parameters/set points common to both Primary and Secondary Motor Settings. The Common Settings are always active independent of the FLC SELECT input.
4. **System Parameters** : displays non adjustable system parameters.

EMX2 FUNCTION LIST

FUNCTION	DESCRIPTION	CATEGORY
0	Run Mode	
1 2 3 4 5 6 7 8 9	Motor Full Load Current Current Limit Initial Start Current Start Ramp Rate Soft Stop Ramp Rate Motor Start Time Constant Phase Imbalance Protection Undercurrent Protection Electronic Shearpin Protection	**Primary Motor Settings** (active when FLC SELECT (terminals C13,C14) open) Use For : Single Speed Motors Dual Speed Motors (Primary Speed)
11 12 13	Phase Sequence Protection LCD Display Mode CT Primary Current Rating	**Common Parameter Settings** (active for both Primary and Secondary Motor Settings)
14 15 16 17 18 19		**Factory Settings** (Do NOT adjust)
20	EMX2 Software Version	**System Parameters** (read only)
21 22 23 24 25 26 27 28 29	Motor Full Load Current Current Limit Initial Start Current Start Ramp Rate Soft Stop Ramp Rate Motor Start Time Constant Phase Imbalance Protection Undercurrent Protection Electronic Shearpin Protection	**Secondary Motor Settings** (active when FLC SELECT (terminals C13,C14) closed) Use For : Dual Speed Motors (Secondary Speed)
30	Restart Delay	**Common Parameter Settings** (active for both Primary and Secondary Motor Settings)

Programming Procedure

The EMX2 Function set points are adjustable using the Data Entry Key Pad



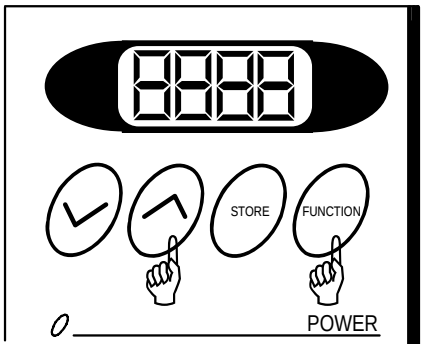
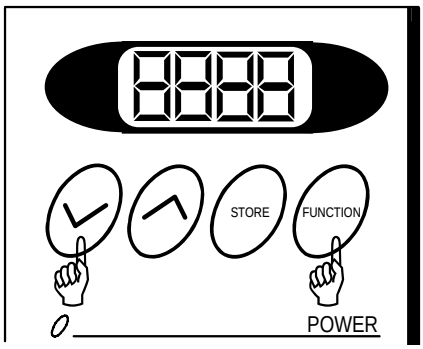
1. **LCD Display** : Used to display Function Number & Function set points during EMX2 programming.
2. **Down Arrow Key** : Use to decrease the parameter count shown on the LCD Display. The count will decrease slowly at first, and then at a fast rate if the key is pressed and held.
3. **Up Arrow Key** : Use to increase the parameter count shown on the LCD Display. The count will increase slowly at first, and then at a fast rate if the key is pressed and held.
4. **Store Key** : Use to store the altered Parameter screen set point into memory.
5. **Function Key** : Use with the Up and Down arrow keys to select the required Function Screen.
6. **Fault/Status Display** : Displays Status/Fault information when EMX2 in run mode. All LEDs illuminate when EMX2 in programme mode or when the Function Key is pressed.

The **Program Mode** can be activated only when :

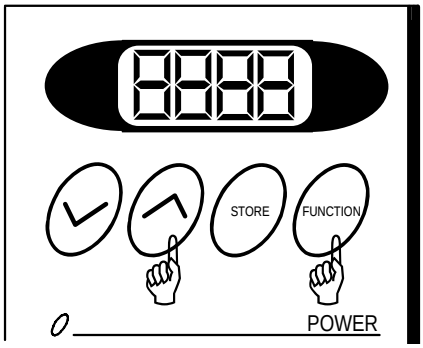
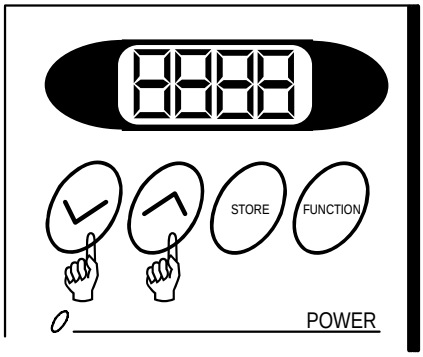
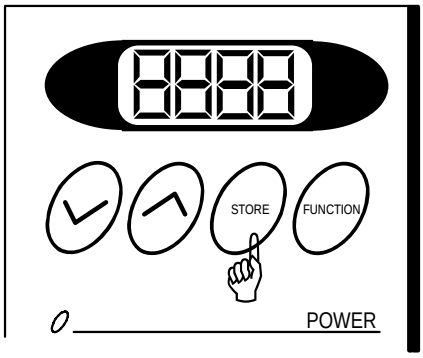
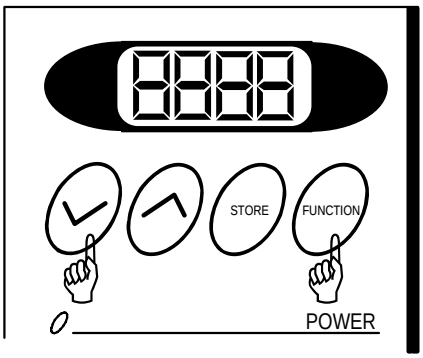
- The EMX2 is stopped, and all trip states reset.
- The Reset Circuit (Terminals C41,C42) is closed

The EMX2 cannot be run when in the program mode.

READ PARAMETER PROCEDURE

STEP 1		**Enter Program Mode & Select Desired Function Screen** **1.** Press and hold the ***<FUNCTION>*** Key. All Fault/Status Display LEDs should illuminate. **2.** Using the ***<UP>*** or ***<DOWN>*** keys select the required function number. **3.** When the required function number is displayed, release the ***<FUNCTION>*** Key. The LCD Display changes to show the parameter set point currently stored in memory.
STEP 2		Repeat Step 1 for each Function to be read.
STEP 3		**Exit Programming Mode** **1.** Using the ***<FUNCTION>*** and ***<DOWN>*** keys select Function 0 (RUN MODE). All Fault/Status Display LEDs, except the POWER LED should now extinguish.

PROGRAM PARAMETER PROCEDURE

STEP 1		**Enter Program Mode & Select Desired Function Screen** **1.** Press and hold the ***<FUNCTION>*** Key. All Fault/Status Display LEDs should illuminate. **2.** Using the ***<UP>*** or ***<DOWN>*** keys select the required function number. **3.** When the required function number is displayed, release the ***<FUNCTION>*** Key. The LCD Display changes to show the parameter set point currently stored in memory.
STEP 2		**Alter Function Setpoint** **1.** Review the current parameter set point and, if necessary, use the ***<UP>*** or ***<DOWN>*** keys to display the desired new set point. (Note that pressing the ***<FUNCTION>*** Key will return the display to the last stored parameter set point)
STEP 3		**Store The New Function Setpoint** **1.** Press the ***<STORE>*** key to store the displayed set point into memory. **2.** Verify the new set point has been correctly stored by pressing and then releasing the ***<FUNCTION>*** Key. The LCD display should now show the new setpoint.
STEP 4		Repeat Steps 1, 2 & 3 for each Function to be set.
STEP 5		**Exit Programming Mode** **1.** Using the ***<FUNCTION>*** and ***<DOWN>*** keys select Function 0 (RUN MODE). All Fault/Status Display LEDs, except the POWER LED should now extinguish.

EMX2 Programming functions **PRIMARY MOTOR SETTINGS**

(Set for single speed motors, & primary speed on dual speed motors ; parameters active when FLC Select terminals (C13 & C14) are open.)

FUNCTION	PURPOSE	SETTING INSTRUCTIONS	DESCRIPTION
1. Motor Full Load Current	Sets the EMX2 for the connected motor full load current.	Set to the Full Load Current (Amps) rating shown on the motor nameplate, or motor data sheet.	This parameter is used by the EMX2 : 1. to set the overcurrent protection to the rating of the connected motor. The EMX2 should trip at 105% to 115% of this value after a period of time 2. in the thermal model for motor temperature simulation. 3. in the start current control algorithms. The starting current is set and expressed as a percentage of the Full Load Current setting. This parameter should be set for the actual rated current of the connected motor, not the measured current under load.
2. Current Limit	Sets the maximum start current limit as a percentage of motor full load current (as set in Function 1). Start Current = Motor FLC (Function 1) X Current Limit (Function 2)	Set so that the motor can easily accelerate to full speed and to optimise start characteristics.	This parameter sets the maximum starting current which should occur and is expressed as a percentage of the rated Full Load Current of the Motor. This parameter must be set high enough to allow the motor to develop sufficient torque to start the motor and driven load to full speed. The EMX2 will accept parameter settings up to 550%, however : 1. the Maximum Starter Ratings as detailed on the Application Data Sheet at the front of this Users Manual should not be exceeded. 2. the maximum achievable current limit for this application is limited by the CTs selected for the application, and supplied with the starter..

FUNCTION	PURPOSE	SETTING INSTRUCTIONS	DESCRIPTION
3. Initial Start Current	Sets the initial start current level for the **Current Ramp** start mode.	If the Current Ramp start mode is required, set the Initial Start Current so that the motor begins to accelerate immediately a start is initiated. If the Current Ramp start mode is not required, set the Initial Start Current equal to the Current Limit (Function 2).	This function and the Start Ramp Time (Function 4) are used together to select and adjust the Current Ramp start mode. This parameter sets the initial start current as a percentage of the rated Full Load Current of the motor. At the initiation of a start, the start current rapidly rises from zero to this current setting. If this current is less than the Current Limit (Function 2) and the Start Ramp Time (Function 4) is set greater than zero, the start current will be controlled to rise to the programmed Current Limit level over the time specified by the Start Ramp Time function. If this parameter is equal to the Current Limit (Function 2) and/or the Start Ramp Time (Function 4) is set to 0 seconds, a Constant Current start will result.
4. Start Ramp Time	Sets the ramp time for the **Current Ramp** start mode.	If the Current Ramp start mode is required, set the Start Ramp Time to optimise start characteristics. If the Current Ramp start mode is not required, set the Start Ramp Time to 0.	This function and the Initial Start Current (Function 3) are used together to select and adjust the Current Ramp start mode. This parameter sets the time taken for the start current to ramp from the Initial Start Current (Function 3) setting to the Current Limit (Function 2) setting. If this parameter is set to 0 seconds, and/or the Initial Start Current (Function 3) is set equal to the Current Limit (Function 2), a Constant Current start will result.
5. Soft Stop Ramp Time	Sets the soft stop ramp time for soft stopping of the motor.	If Soft Stop required, set to produce desired motor stopping performance. If Soft Stop not required, set the Soft Stop Ramp Time to 0 seconds.	This parameter sets the time taken for the voltage to be ramped from line voltage to zero, on the initiation of a stop. If set to 0 seconds soft stop is defeated. Soft Stop effectively adds inertia to a low inertial application which would normally stop immediately. ie pumps, conveyors.

FUNCTION	PURPOSE	SETTING INSTRUCTIONS	DESCRIPTION
6. Motor Start Time Constant (MSTC)	Sets the motor thermal capacity used by the EMX2 thermal motor model.	The MSTC parameter can be set up to the maximum motor's maximum thermal capacity (Refer to adjacent Description section for detail on determining the maximum MSTC figure ⇨), however, where this is not necessary greater motor protection is achieved with a reduced MSTC setting. (Refer to adjacent Description section for detail on selecting a reduced MSTC figure ⇨)	The MSTC parameter is used by the EMX2 thermal motor model to set the rate of change of the modelled motor temperature. The maximum recommended Motor Start Time Constant (MSTC) setting is determined by the connected motor's thermal capacity, and can be established in one of two ways: 1. MSTC = Motors maximum start time rating (from cold). 2. The above method assumes a Locked Rotor Current of 600%. Greater accuracy will be achieved by normalising this figure to the actual locked rotor current figure of the motor by multiplying the maximum locked rotor time of the motor by the square of the ratio between the actual locked rotor current and 600. ie MSTC = $\left(\frac{\%LRC}{600}\right)^2$ X Max Start Time The best MSTC setting is dependent on considerations specific to the application. If the application needs to make use of the motor's maximum overload capacity to start the motor or maintain continuous operation, then the maximum MSTC figure would be appropriate. If not, the best setting is a reduced MSTC figure which allows uninterrupted motor operation and trips the motor as early as possible in the event of abnormal overloads. A suitable MSTC figure can be established by : observing the modelled motor temperature as shown on the EMX2 LCD Display, and adjusting the MSTC parameter such that after a normal start which has been preceded by a period of running at maximum load, the calculated motor temperature is approaching 90%. **MAXIMISING MOTOR PROTECTION** **The life of a motor is strongly influenced by its maximum winding temperature, with a 'rule of thumb' stating that the expected life span of a motor is halved for every ten degree rise in temperature. The temperature rise is dependent on the motor losses and the motor cooling. The highest stress on the motor is during start, and can be minimised by restricting the duration and frequency of starts. A reduced MSTC setting (Function 6) will also cause the EMX2 protection to operate before the motor is thermally stressed. For maximum motor life set the MSTC to a reduced level, using the maximum or normalised figures only where absolutely required.**

FUNCTION	PURPOSE	SETTING INSTRUCTIONS	DESCRIPTION
7. Phase Imbalance Protection	Sets the level of imbalance allowed between phases while the motor is operating.	Set to desired sensitivity level. Settings 1 minimum imbalance (highest sensitivity) ⋮ 10 maximum imbalance (lowest sensitivity)	This parameter is used to set the sensitivity of the Phase Imbalance Protection to an imbalance in the three phase currents. The EMX2 monitors the three phase currents and bases its calculations on the difference between the highest phase current and the lowest phase current. The readings are averaged before the calculation requiring that there is an imbalance in the average currents drawn. The parameter sets the protection in ten percent increments, ie a setting of '2' will cause a trip if the high phase has an average current of 120% of the lowest phase. This is an imbalance of about 10% from the average current. (accuracy subject to tolerance of current monitoring circuit) The phase imbalance protection sensitivity is reduced during starting and stopping to accommodate the discontinuous waveform.

FUNCTION	PURPOSE	SETTING INSTRUCTIONS	DESCRIPTION
8. Undercurrent Protection	Sets the trip point for the EMX2 undercurrent protection. ie the lower limit of motor load as a percentage of motor full load current (as set in Function 1).	If undercurrent protection is required, set below the lower limit of the motor's normal working range. If undercurrent protection is not required, set below the motor's magnetising (no load) current.	This parameter sets the undercurrent protection threshold and is expressed as a percentage of rated Full Load Current of the motor. Undercurrent protection is only enabled once the motor has reached full speed and will cause the starter to trip if the measured three phase current is less than this setting. Undercurrent protection is primarily used to detect a drop in load on a machine such as a pump running dry, or an open circuit isolate on the output of a starter. The setting must be less than the minimum running current of the machine, but greater than the magnetising current of the motor for the protection to operate. A setting of less than the magnetising current of the motor will offer open circuit protection only. The magnetising current of a motor is typically 25% to 35% of the rated Full Load Current.
9. Electronic Shearpin Protection	Sets the trip threshold for the EMX2 Electronic Shearpin protection as a percentage of Motor Full Load Current. (as set in Function 1).	This protection is set equal to the Current Limit parameter, but can be reduced to a lower level if required.	This parameter sets the trip threshold for the Electronic Shearpin protection and is expressed as a percentage of rated Full Load Current of the motor. The protection is enables only after the motor reaches full speed and will cause the starter to trip if the measured current exceeds this setting, or reaches the maximum input of the current monitoring circuitry.

EMX2 Programming functions **COMMON PARAMETER SETTINGS**
(Active for both Primary and Secondary Motor Settings.)

FUNCTION	PURPOSE	SETTING INSTRUCTIONS	DESCRIPTION
11. Phase Sequence Protection	Sets the valid phase sequences for the EMX2 Phase Sequence Protection.	Set for the desired valid phase sequence. Valid Phase Sequences . 0 forward and reverse (no protection) 1 forward (positive) only 2 reverse (negative) only	This parameter is used to enable or disable the Phase Sequence Protection, and if enabled to set the required valid phase sequence.
12. LCD Display Mode	Selects the parameter(s) displayed by the EMX2 LCD Display during run.	Set for the desired run-time display mode. Run-Time Display Parameter (s) . 0 motor current 1 motor temperature (Thermal Model) 2 motor current/motor temperature	This parameter select the parameter displayed on the EMX2 LCD Display during operation. The motor current is an absolute current and displayed in Amps. Note that the integrity of the current display is subject to the EMX2 being correctly programmed with Primary Rating of the connected CTs, and the correct installation of the CTs. During commissioning of the EMX2 the LCD current display should not be relied upon until its operation has been verified by measuring motor current by an independent means. The motor temperature is displayed as a percentage of the maximum motor temperature as calculated by the Thermal Model. The motor temperature display is indicated by a leading decimal point. ie 90% reads as .90 and 100% as 1.00. The EMX2 will trip when the motor temperature reaches 1.05. Where display mode 2 is selected, the display toggles between the current and temperature, primarily displaying current but briefly cycling to temperature on a regular basis.

FUNCTION	PURPOSE	SETTING INSTRUCTIONS	DESCRIPTION
13. Current Transformer Primary Current Rating	Sets the value of the primary current of the EMX2 soft starter current transformers	Set to the Primary Current Rating of the Current Transformers connected to the EMX2. (ie CT Ratio 400/5, Primary Current Rating = 400A) When setting this parameter verify that the connected CTs are the same CTs supplied with the EMX2 and detailed on the Application Data Sheet on the first page of this Users Manual.	This parameter tells the EMX2 what CTs are connected to enable it to correctly translate the input currents from the CTs into absolute currents for use in the starting and thermal model calculations. IT IS IMPERATIVE THAT THIS PARAMETER IS SET CORRECTLY FOR THE CONNECTED CTS AND THAT THE CTS HAVE 5 A SECONDARIES. IF THIS PARAMETER IS INCORRECTLY SET, THE START PERFORMANCE, DISPLAYED CURRENT READINGS, OVERCURRENT, UNDERCURRENT AND SHEARPIN PROTECTION WILL BE INACCURATE.

EMX2 Programming functions **SECONDARY MOTOR SETTINGS**

(set for dual speed motor applications or similar; parameters active when FLC Select terminals (C13 & C14) are closed.)

FUNCTION	PURPOSE	SETTING INSTRUCTIONS	DESCRIPTION
21. **Secondary** Motor Full Load Current	Sets the EMX2 for the secondary motor full load current.	Set to the secondary Full Load Current (Amps) rating shown on the motor nameplate, or motor data sheet.	This parameter is used by the EMX2 : 1. to set the overcurrent protection to the rating of the connected motor. The EMX2 should trip at 105% to 115% of this value after a period of time 2. in the thermal model for motor temperature simulation. 3. in the start current control algorithms. The starting current is set and expressed as a percentage of the Full Load Current setting. This parameter should be set for the actual rated current of the connected motor, not the measured current under load.
22. **Secondary** Current Limit	Sets the maximum start current limit for the secondary motor speed as a percentage of motor full load current (as set in Function 21). Start Current = Motor FLC X Current Limit (Function 21) (Function 22)	Set so that the motor can easily accelerate to full speed and to optimise start characteristics.	This parameter sets the maximum starting current which should occur and is expressed as a percentage of the rated Full Load Current of the Motor. This parameter must be set high enough to allow the motor to develop sufficient torque to start the motor and driven load to full speed. The EMX2 will accept parameter settings up to 550%, however : 1. the Maximum Starter Ratings as detailed on the Application Data Sheet at the front of this Users Manual should not be exceeded. 2. the maximum achievable current limit for this application is limited by the CTs selected for the application, and supplied with the starter..

FUNCTION	PURPOSE	SETTING INSTRUCTIONS	DESCRIPTION
23. **Secondary** Initial Start Current	Sets the initial start current level for the **Current Ramp** start mode for the secondary motor speed.	If the Current Ramp start mode is required, set the Initial Start Current so that the motor begins to accelerate immediately a start is initiated. If the Current Ramp start mode is not required, set the Initial Start Current equal to the Current Limit (Function 22).	This function and the Start Ramp Time (Function 4) are used together to select and adjust the Current Ramp start mode. This parameter sets the initial start current as a percentage of the rated Full Load Current of the motor. At the initiation of a start, the start current rapidly rises from zero to this current setting. If this current is less than the Current Limit (Function 2) and the Start Ramp Time (Function 4) is set greater than zero, the start current will be controlled to rise to the programmed Current Limit level over the time specified by the Start Ramp Time function. If this parameter is equal to the Current Limit (Function 2) and/or the Start Ramp Time (Function 4) is set to 0 seconds, a Constant Current start will result.
24. **Secondary** Start Ramp Time	Sets the ramp time for the **Current Ramp** start mode for the secondary motor speed.	If the Current Ramp start mode is required, set the Start Ramp Time to optimise start characteristics. If the Current Ramp start mode is not required, set the Start Ramp Time to 0.	This function and the Initial Start Current (Function 23) are used together to select and adjust the Current Ramp start mode. This parameter sets the time taken for the start current to ramp from the Initial Start Current (Function 23) setting to the Current Limit (Function 22) setting. If this parameter is set to 0 seconds, and/or the Initial Start Current (Function 23) is set equal to the Current Limit (Function 22), a Constant Current start will result.
25. **Secondary** Soft Stop Ramp Time	Sets the soft stop ramp time for soft stopping of the motor when in the secondary motor speed.	If Soft Stop required, set to produce desired motor stopping performance. If Soft Stop not required, set the Soft Stop Ramp Time to 0 seconds.	This parameter sets the time taken for the voltage to be ramped from line voltage to zero, on the initiation of a stop. If set to 0 seconds soft stop is defeated. Soft Stop effectively adds inertia to a low inertial application which would normally stop immediately. ie pumps, conveyors.

FUNCTION	PURPOSE	SETTING INSTRUCTIONS	DESCRIPTION
26. **Secondary** Motor Start Time Constant (MSTC)	Sets the motor thermal capacity used by the EMX2 thermal motor model.	The MSTC parameter can be set up to the maximum motor's maximum thermal capacity (Refer to adjacent Description section for detail on determining the maximum MSTC figure ⇨), however, where this is not necessary greater motor protection is achieved with a reduced MSTC setting. (Refer to adjacent Description section for detail on selecting a reduced MSTC figure ⇨)	The MSTC parameter is used by the EMX2 thermal motor model to set the rate of change of the modelled motor temperature. The maximum recommended Motor Start Time Constant (MSTC) setting is determined by the connected motor's thermal capacity, and can be established in one of two ways: 1. MSTC = Motors maximum start time rating (from cold). 2. The above method assumes a Locked Rotor Current of 600%. Greater accuracy will be achieved by normalising this figure to the actual locked rotor current figure of the motor by multiplying the maximum locked rotor time of the motor by the square of the ratio between the actual locked rotor current and 600. ie MSTC = $\left(\frac{\%LRC}{600}\right)^2$ X Max Start Time The best MSTC setting is dependent on considerations specific to the application. If the application needs to make use of the motor's maximum overload capacity to start the motor or maintain continuous operation, then the maximum MSTC figure would be appropriate. If not, the best setting is a reduced MSTC figure which allows uninterrupted motor operation and trips the motor as early as possible in the event of abnormal overloads. A suitable MSTC figure can be established by : observing the modelled motor temperature as shown on the EMX2 LCD Display, and adjusting the MSTC parameter such that after a normal start which has been preceded by a period of running at maximum load, the calculated motor temperature is approaching 90%. **MAXIMISING MOTOR PROTECTION** **The life of a motor is strongly influenced by its maximum winding temperature, with a 'rule of thumb' stating that the expected life span of a motor is halved for every ten degree rise in temperature. The temperature rise is dependent on the motor losses and the motor cooling. The highest stress on the motor is during start, and can be minimised by restricting the duration and frequency of starts. A reduced MSTC setting (Function 6) will also cause the EMX2 protection to operate before the motor is thermally stressed. For maximum motor life set the MSTC to a reduced level, using the maximum or normalised figures only where absolutely required.**

FUNCTION	PURPOSE	SETTING INSTRUCTIONS	DESCRIPTION
27. **Secondary** Phase Imbalance Protection	Sets the level of imbalance allowed between phases while the motor is operating in its secondary speed..	Set to desired sensitivity level. Settings . 1 minimum imbalance (highest sensitivity) ⋮ 10 maximum imbalance (lowest sensitivity)	This parameter is used to set the sensitivity of the Phase Imbalance Protection to an imbalance in the three phase currents. The EMX2 monitors the three phase currents and bases its calculations on the difference between the highest phase current and the lowest phase current. The readings are averaged before the calculation requiring that there is an imbalance in the average currents drawn. The parameter sets the protection in ten percent increments, ie a setting of '2' will cause a trip if the high phase has an average current of 120% of the lowest phase. This is an imbalance of about 10% from the average current. (accuracy subject to tolerance of current monitoring circuit) The phase imbalance protection sensitivity is reduced during starting and stopping to accommodate the discontinuous waveform.

FUNCTION	PURPOSE	SETTING INSTRUCTIONS	DESCRIPTION
28. **Secondary** Undercurrent Protection	Sets the trip point for the EMX2 undercurrent protection when the motor is operating in its secondary speed. ie the lower limit of motor load as a percentage of motor full load current (as set in Function 21).	If undercurrent protection is required, set below the lower limit of the motor's normal working range. If undercurrent protection is not required, set below the motor's magnetising (no load) current.	This parameter sets the undercurrent protection threshold and is expressed as a percentage of rated Full Load Current of the motor. Undercurrent protection is only enabled once the motor has reached full speed and will cause the starter to trip if the measured three phase current is less than this setting. Undercurrent protection is primarily used to detect a drop in load on a machine such as a pump running dry, or an open circuit isolator on the output of a starter. The setting must be less than the minimum running current of the machine, but greater than the magnetising current of the motor for the protection to operate. A setting of less than the magnetising current of the motor will offer open circuit protection only. The magnetising current of a motor is typically 25% to 35% of the rated Full Load Current.
29. **Secondary** Electronic Shearpin Protection	Sets the trip threshold for the EMX2 Electronic Shearpin protection, when operating in its secondary speed, as a percentage of Motor Full Load Current. (as set in Function 21).	This protection is set equal to the Current Limit parameter, but can be reduced to a lower level if required.	This parameter sets the trip threshold for the Electronic Shearpin protection and is expressed as a percentage of rated Full Load Current of the motor. The protection is enables only after the motor reaches full speed and will cause the starter to trip if the measured current exceeds this setting, or reaches the maximum input of the current monitoring circuitry.
30. Restart Delay	Sets the time delay between the end of a stop and the beginning of the next start.	The default setting for this function is 15 seconds. This should only be shortened if essential for process requirements.	The Restart Delay is designed to prevent inadvertent abuse of the starter caused by faulty control circuitry subjecting the starter to high frequency cyclic start/stop commands.

SECTION 10 TROUBLE SHOOTING GUIDE

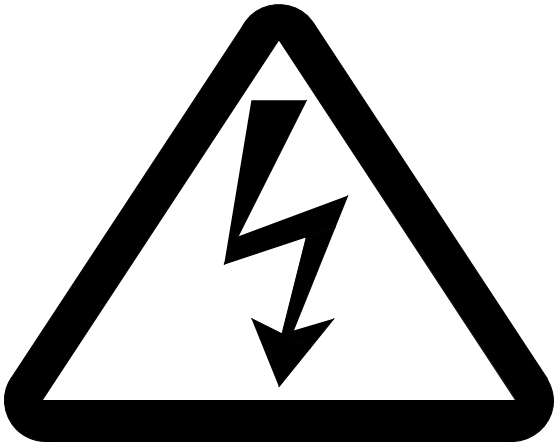
Overview : This section details the EMX2 diagnostic displays and provides assistance in identifying system faults.

Content :
Trouble Shooting Chart 10-2

READ MANUAL COMPLETELY PRIOR TO CONNECTING AND COMMISSIONING THIS EQUIPMENT

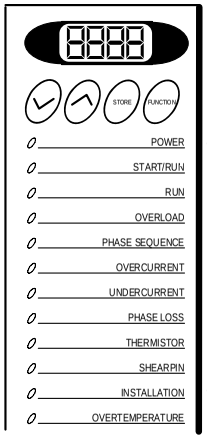
Fault finding and/or repair of this equipment must be undertaken only by suitably qualified personnel.

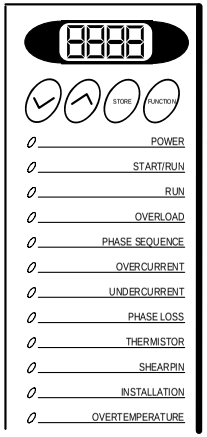
WARNING

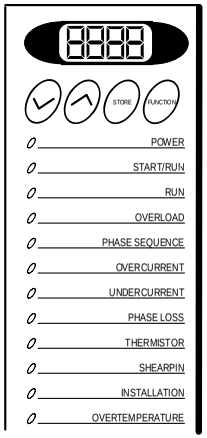
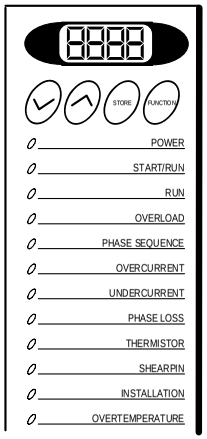


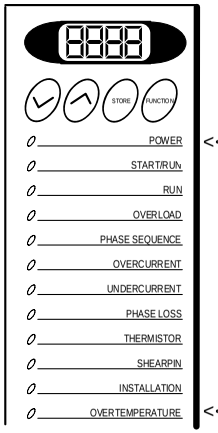
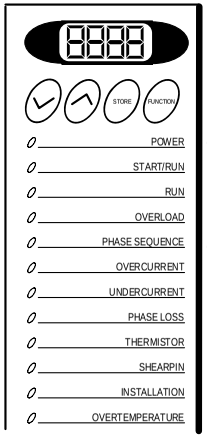
ELECTRICAL SHOCK HAZARD

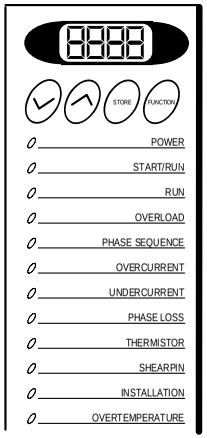
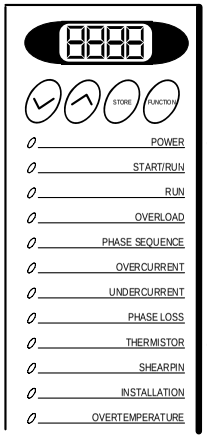
ENSURE THE EMX2 IS COMPLETELY ISOLATED FROM THE POWER SUPPLY BEFORE ATTEMPTING ANY WORK ON THE UNIT

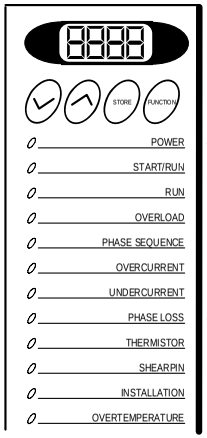
DISPLAY / SYMPTOM	DESCRIPTION / CAUSE	ACTION / TEST	REF.
 <<POWER [FLASH] << INSTALLATION [ON]	No Three Phase, Or Phase Loss, At Prestart Checks When a start is initiated the EMX2 expects to find : a) three phase present on the inputs b) continuous circuits on each output Most likely cause of problems: a) input isolator open b) output isolator open c) links not fitted to motor d) supply or semiconductor fuses not installed e) contactor not closing f) motor incorrectly wired in three wire g) motor incorrectly wired in six wire Installation trips can occur only during pre-start checks. If an Installation trip appears to occur during run, the control input signals may be intermittent and have commanded the EMX2 to stop then immediately restart.	With the input isolator open, measure the output connection. i) If the motor is connected in the three wire connection, there should be a very low resistance between all three output terminals. i.e. T1/2, T2/4, T3/6. This should be the resistance of the stator winding and will be a very low value. If there is a high value of resistance or an open circuit, check the connections to the motor and output isolator if employed. ii) If the motor is connected in the six wire connection, there should be a very low resistance between each output terminal and an input terminal. This should be the resistance of the stator winding and will be a very low value. i.e. T1/2 - L2/3, T2/4 - L3/5, T3/6 - L1/1 or T1/2 - L3/5, T2/4 - L1/1, T3/6 - L2/3. If there is a high value of resistance or an open circuit, check the connections to the motor and output isolator if employed. Locate the input isolator. With the input isolator closed, measure the three phase voltages on the input to the isolator and the output of the isolator. If no volts present on the input check for inline fuses. If an input contactor is not used, measure the three phase voltages on the input to the EMX2. L1/1, L2/3, L3/5. If no voltage is present, check for inline fuses. If an input contactor is used: i) measure the three phase voltage on the input of the contactor. ii) ensure the contactor operates when the starter is required to start. If the contactor does not operate, check the control circuitry connected to the contactor coil. Check that when the contactor closes, three phase voltages are present on the input to the EMX2. Verify the integrity of the stop circuit to the EMX2. Note that the stop input is active 24VDC. Contacts used for controlling this input should be low voltage, low current rated.	Section 6

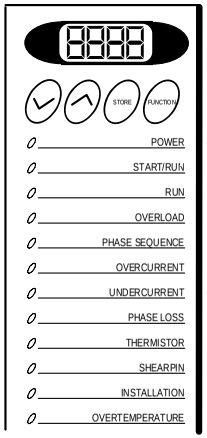
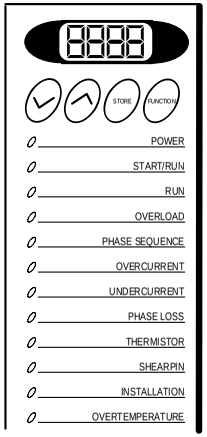
DISPLAY / SYMPTOM	DESCRIPTION / CAUSE	ACTION / TEST	REF.
 << POWER [FLASH]	■ Frequency Out Of Range The EMX2 measures the supply frequency and expects this to be either : a) 48 - 52 Hz b) 58 - 62 Hz Most likely cause of problems a) Loss of input three phase while motor is running b) Genset Governor Out Of Calibration ■ Restart Delay Function Operative	Check supply Wait for timeout of the Restart Delay and try again.	

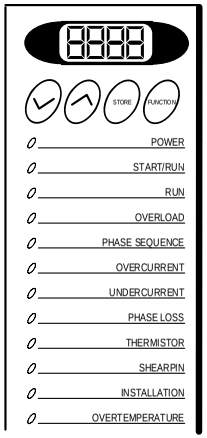
DISPLAY / SYMPTOM	DESCRIPTION / CAUSE	ACTION / TEST	REF.
 << POWER [FLASH] << INSTALLATION [FLASH] **OR**  << POWER [ON] << INSTALLATION [ON]	Installation Fault Before starting, the EMX2 expects the three phases to be present and correctly positioned relative to each other, i.e. 120 degrees apart. The EMX2 monitors the waveform between the input and the output on each phase and measures the phase relation ship between them. Most likely causes of problems are: a) severe phase shift in one phase of the supply b) low voltage on one phase of the supply c) incorrect motor wiring in three wire connection d) incorrect wiring in six wire connection e) circuits other than just motor connected to output f) very distorted supply waveform g) significant leakage through the SCRs h) failed SCR(s) i) control pcb fault Installation trips can occur only during pre-start checks. If an Installation trip appears to occur during run, the control input signals may be intermittent and have commanded the EMX2 to stop then immediately restart.	a) three wire installation on a supply with earthed neutral, with three phase voltage on the input, and the starter in the OFF mode, measure the voltage between the outputs and neutral (or earth). This should read less than 10 volts. b) three wire installation on a supply with no neutral, with three phase voltage on the input, and the starter in the OFF mode, measure the voltage from input to output on each phase, i.e. L1/1 - T1/2, L2/3 - T2/4, L3/5 - T3/6. The voltages should be very close to equal. c) six wire installation: measure the voltage from input to output on each phase, i.e. L1/1 - T1/2, L2/3 - T2/4, L3/5 - T3/6. The voltages should be very close to equal. d) with both the supply and motor disconnected, and using a 500V insulation tester (low voltage ohm meters or multi-meters are not adequate), measure the resistance between the input and output on each phase. L1/1 - T1/2, L2/3 - T2/4, L3/5 - T3/6. The resistance should be close to 33Kohms. If significantly less than 33Kohms, then there could be excess leakage through the SCRs. If signficiantly greater than 33Kohm, then there could be a control pcb fault. Verify the integrity of the stop circuit to the EMX2. Note that the stop input is active 24VDC. Contacts used for controlling this input should be low voltage, low current rated.	

DISPLAY / SYMPTOM	DESCRIPTION / CAUSE	ACTION / TEST	REF.
 << POWER [ON] << OVERTEMPERATURE [ON]	EMX2 Overtemperature The EMX2 monitors the internal heatsink temperature and will trip and not restart immediately after an over temperature trip until the heatsinks have cooled a little. Most likely causes of problems are: a) poor ventilation b) recirculation of exhaust air c) cooling fans not operating d) extended starting beyond the starter ratings e) loose EMX2 temperature sensor leads	Ensure that starters immediate ambient temperature does not exceed unit ratings. Ensure that there is adequate ventilation in the enclosure into which the starter has been mounted. Ensure that actual operating duty is within starter ratings. Ensure heated exhaust air is not re-circulating back to the air intake. Verify that the EMX2 internal temperature sensor leads are securely connected to the Main Control PCB and the Snubber PCBs.	Section 5
 << POWER [ON] << PHASE SEQUENCE [ON]	Invalid Phase Sequence The EMX2 compares the measured phase sequence on the input terminals with the required phase sequence and will not start unless a valid measurement is made.	Check the incoming phase sequence against the Valid Phase Sequences programmed in Function 11. Rotate supply cables or adjust Valid Phase Sequence setting as appropriate.	Section 3

DISPLAY / SYMPTOM	DESCRIPTION / CAUSE	ACTION / TEST	REF.
 << OVERCURRENT [ON]	Overcurrent Trip The EMX2 monitors the current drawn by the motor and mathematically models the expected motor temperature using the motor start time constant set in the starter parameters. The EMX2 will trip if the modelled temperature reaches 105%. The EMX2 will not allow a restart after an over current trip until the thermal model has reached a temperature below the trip temperature. NB (The motor must be allowed to cool sufficiently for a hot restart to occur. If the thermal margin is small, the motor may only get to part speed before re-tripping.) Most likely causes of problems are: a) motor overloaded b) motor flc parameter setting incorrect c) C.T. primary parameter setting incorrect d) Motor restarted too soon after stop or trip e) current additional to motor current passing through the CTs	Check motor and/or load for cause of motor overload. Allow motor time to cool, reset and restart. Ensure Motor FLC (Function 1) and Motor Start Time Constant (Function 6) are set correctly for the connected motor. Ensure Start Current Ratio is adequate to allow the motor to easily accelerate to full speed.	Section 3
 << POWER [ON] << THERMISTOR [ON]	Thermistor Trip The EMX2 monitors the thermistor input and will trip (or not restart) if there is a thermistor fault present. Most likely causes of problems are: a) hot motor (thermistors operating correctly) b) open circuit in thermistor circuit. c) thermistors not connected and no shorting link fitted	Wait for motor to cool. If no motor thermistors are connected ensure that a link is fitted across EMX2 motor thermistor terminals (B4,B5). Check thermistor circuit.	Section 3

DISPLAY / SYMPTOM	DESCRIPTION / CAUSE	ACTION / TEST	REF.
 << POWER [ON] << PHASE LOSS [ON]	Phase Loss Trip The EMX2 monitors the current drawn on each phase and calculates the difference between the currents flowing on the three phases. The difference between the highest phase and the lowest phase is compared with the acceptable limit set in the starter parameters (user selectable) and trips if there is a continuous condition outside the preset limits. Most likely causes of problems are: a) one phase low in voltage b) motor problem c) loose cable or busbar joint d) unequal C.T. ratios e) incorrect C.T. wiring f) current additional to motor current passing through CTS	Ensure that all three phases are present at the EMX2 input. Measure phase to phase, and phase to neutral for each phase. Ensure that the circuit from the EMX2 to the motor is complete. 3 Wire Completely isolate the EMX2 from the supply and using a meter measure the circuit between each of the three outputs. 6 Wire Completely isolate the EMX2 from the supply and using a meter, measure the circuit between each of the outputs and inputs. There should be NO circuits measured between the outputs, (T1/2-T2/4-T3/6). Note that it may be necessary to remove the control circuit fuses to isolate the fans from the inputs. A circuit must be measured from each of the outputs to an input, but the input must not be on the same phase. Acceptable combinations are T1/2-L2/3,T2/4-L3/5,T3/6-L1/1 or T1/2-L3/5,T2/4-L1/1,T3/6-L2/3	Section 3 Section 6 Section 6

DISPLAY / SYMPTOM	DESCRIPTION / CAUSE	ACTION / TEST	REF.
 << POWER [ON] << UNDERCURRENT [ON]	Motor Undercurrent Trip The EMX2 monitors the running current of the motor and trips if this falls below the under current limit set in the starter parameters. Most likely causes of problems are: a) broken belts b) pump running dry	Check load for cause of undercurrent situation. The EMX2 will trip at the undercurrent level set in Function 8. Reset and Restart.	Section 3
 << POWER [ON] << SHEARPIN [ON]	Electronic Shearpin Trip The EMX2 monitors the current drawn by the motor and trips if the shear pin limit set in the starter parameters is exceeded. Most likely causes of problems are: a) motor severely overloaded b) driven load jammed c) power factor correction connected on output of EMX2	Check motor and load for cause of instantaneous overload. Reset and restart.	Section 3

DISPLAY / SYMPTOM	DESCRIPTION / CAUSE	ACTION / TEST	REF.
 << POWER [ON] << OVERLOAD	Motor operating in overload. ■ Overload Indication [Flickering] ■ Overload [ON]	Dependant on application requirement. Transient/Short Term overloads are a normal part motor operation for some load types. Extended operation in an overloaded state may cause an overcurrent trip depending on the magnitude of the overload. Check motor/machine loading.	Section 3
Front Panel Display Not Functioning Or Operating Erratically.	No, or incorrect, control voltage applied to the EMX2.	Ensure the correct voltage is applied to the EMX2 Control and Fan Supply terminals (A1,A2,A3) Ensure all supply phases are present.	Section 7

DISPLAY / SYMPTOM	DESCRIPTION / CAUSE	ACTION / TEST	REF.
EMX2 Will Not Enter Program Mode	■ Incorrect programming procedure.	Use both ***<FUNCTION>*** AND ***<UP>*** keys to select desired program function.	Section 9
	■ Reset circuit not closed.	Check integrity of Reset circuit.	
	■ EMX2 trip state not reset.	Reset EMX2.	
	■ EMX2 is running.	Stop EMX2	
	■ Incorrect, control voltage applied to the EMX2.	Ensure the correct voltage is applied to the EMX2 Control and Fan Supply terminals (A1,A2,A3)	
	■ Damaged EMX2 Control Inputs.	Verify the integrity of the EMX2 Start, Stop & Reset control inputs by placing an ammeter in series with each of the control inputs. The ammeter should measure a DC current greater than 5mA under normal circumstances. If no current is measured replace damaged control PCBs.	
EMX2 Will Not Store Programmed Function Settings	■ Incorrect programming procedure.	User programmed settings must be stored by using the ***<STORE>*** key, before moving to another Function No.	Section 9
	■ Parameter set point is outside allowable limits.	Ensure programmed set point is within EMX2 limits.	Section 3

DISPLAY / SYMPTOM	DESCRIPTION / CAUSE	ACTION / TEST	REF.
EMX2 Does Not Respond To Start Signal.	■ EMX2 is still in program mode. All LED are illuminated.	Exit program mode by using the ***<FUNCTION>*** and ***<DOWN>*** keys to select Function 0 (RUN MODE).	Section 9
	■ Restart Delay function operative.	Wait for timeout of the Restart Delay and try again.	Section 3
	■ Stop and/or Reset circuits open.	Ensure that circuits connected to the EMX2 Stop terminals (C31,C32) and Reset terminals (C41,C42) are closed. If no external circuits are connected, ensure a link is fitted. Verify the integrity of circuits connected to EMX2 Start, Stop, Reset and FLC Select control inputs. Switch contacts used in these circuits should suitable for use with electronic circuits. Circuit integrity may be checked using a volt meter and measuring the voltage across the terminals. If there is 24VDC measured across either of the terminals when the switch is closed, the switch/control is connected incorrectly or is faulty.	Section 7
	■ No, or incorrect control voltage applied to the EMX2.	Ensure the correct voltage is applied to the EMX2 Control and Fan Supply terminals (A1,A2,A3).	Section 7
	■ Damaged EMX2 Control Inputs.	Verify the integrity of the EMX2 Start, Stop & Reset control inputs by placing an ammeter in series with each of the control inputs. The ammeter should measure a DC current greater than 5mA under normal circumstances. If no current is measured replace damaged control PCBs.	

DISPLAY / SYMPTOM	DESCRIPTION / CAUSE	ACTION / TEST	REF.
Measured Start Current Different To Programmed Start Current.	■ Function set points not set as expected due to incorrect programming procedure.	Check function set points. User programmed settings must be stored by using the ***<STORE>*** key, before moving to another Function No.	Section 9
	■ Incorrect CT Primary Current Rating setting (Function 13)	Ensure that Function 13, CT Primary Current Rating is correctly set for the installed EMX2 CTs.	
	■ Incorrect CTs connected to the EMX2.	Ensure the CTs connected to the EMX2 are those supplied with the EMX2 and detailed in the Application Data Sheet on the first page of this manual.	Section 6
	■ Incorrect CT installation.	Ensure that each of the three EMX2 CTs are installed on different phases, that they monitor line current and are not bypassed by bridging contactors etc.	Section 6
	■ Starter Maximum Ratings Exceeded	Ensure that the programmed Current Limit (Function 2) and Motor FLC (Function 1) parameters do not exceed the EMX2 maximum ratings as detailed in the Applications Data Sheet on the first page of this manual.	Section 6
	■ Incorrect parameter set being used. (ie Primary - Secondary motor settings)	Ensure Primary and Secondary settings are operative as appropriate **Parameter Set** / **Operative When FLC Select Input (Terminals 8,9)** Primary (Functions 1 > 9) — Open Secondary (Functions 21 > 29) — Closed	Section 6
Motor Does Not Breakaway/Accelerate To Full Speed.	■ Insufficient Start Current	Increase the Current Limit setting (Function 2) so that the motor can produce sufficient torque to accelerate the load to full speed. (NOTE : If the motor and load has previously accelerated to full speed at the existing Current Limit setting, ascertain why start torque requirements have increased).	Section 3
	■ Motor/Load jammed.	Ensure motor and load turn freely.	

DISPLAY / SYMPTOM	DESCRIPTION / CAUSE	ACTION / TEST	REF.
Motor Does Not Breakaway Immediately A Start Is Initiated.	Initial Start Current set too low.	If using Uni-Start Current Ramp ensure the Initial Start Current (Function 3) is correctly set. (NOTE : When using Uni-Start Current Ramp there may be some delay in motor breakaway when the machine is heavily loaded.)	Section 3
DOL or Uncontrolled Start	Power Factor Correction capacitors connected to output of EMX2.	Ensure that no power factor correction capacitors are connected on the output of the EMX2. This can cause starter damage. Power Factor Correction capacitors, if used must be fitted on the input side of the starter.	Section 6
	EMX2 CTs not connected to EMX2 terminals (31,32,33 & 34)	Ensure EMX2 CT's are correctly connected.	Section 6
	SCR Failure	Check SCRs	
Soft Stop Does Not Operate	Line contactor being operated by inappropriate stop circuit.	Ensure the line contactor, if used, does not open until the soft stop is completed. The EMX2 Main Contactor relay output (Terminals 13,14) provides appropriate control for line contactors.	Section 7

DISPLAY / SYMPTOM	DESCRIPTION / CAUSE	ACTION / TEST	REF.
Intermittent Starter Operation	Faulty Control Circuits	Verify the integrity of circuits connected to EMX2 Start, Stop, Reset and FLC Select control inputs. Switch contacts used in these circuits should suitable for use with electronic circuits. Circuit integrity may be checked using a volt meter and measuring the voltage across the terminals. If there is 24VDC measured across either of the terminals when the switch is closed, the switch/control is connected incorrectly or is faulty.	Section 4
	■ Restart Delay function operative.	Wait for timeout of the Restart Delay and try again.	Section 3
EMX2 FLC Select Not Working.	Damaged EMX2 Control Inputs.	Verify the integrity of the FLC Select control input by placing an ammeter in series with the FLC Select input. The ammeter should measure a DC current greater than 5mA under normal circumstances. If no current is measured replace damaged control PCBs.	

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